COMMUNICATION : SYMBOLIC AND IMAGINARY - A METATHEORETIC ACCOUNT

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CERTIFICATE

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ABSTRACT

The present thesis is an attempt to understand the important process of communication on which, in part, our long term survival depends. An analysis of the inadequacy of the contemporary, dominant models of the communication process on which diverse, sophisticated information transmission systems are based and built, is carried out. It is argued that, as formal models of communication, they are constrained to ignore the crucial distinction between the 'Symbolic' and 'Imaginary' modes of communication. An alternative epistemology based on that distinction is developed to circumvent the process of decontextualization inherent to formal systems. The problem of 'digitalization' accompanying the creation of 'categories' without which no communication through the use of symbols can take place is sought to be overcome by deploying a framework based on 'levels', 'dimensions', their interrelationships and heterarchy. It is maintained that such a framework subsumes the prevailing models of communication with suitable identification of the associated levels, dimensions and relationships specific to each model. The difficulty of performing such an identification in real life communicational situations is pointed out.

'Existence is beyond the power of words
To define:
Terms may be used
But are none of them absolute. ...

CHAPTER 1

INTRODUCTION

The growing number of large, diverse and sophisticated systems of communication the world over, do not seem to contribute significantly to the process of bridging the communicational gap between people. If any, the gap seems to be widening. We thus have the paradoxical situation in which countries seek to promote peace through the communication acts, such as SALT discussions, that culminate in the greater production of more hazardous nuclear arsenal. We have the embarassingly fast - access systems of communication by which small bands of smugglers and subversive elements can and do escape the net of goverment machinery. We are also witness to the not infrequent phenomenon of a ruthless state backed by expensive and elaborate systems of communication, arresting thousands of its innocent citizens within a matter of a few hours. And, at the interpersonal level, we repeatedly experience the tragic failure of establishing a communicational rapport with the others inspite our best systems for transmission and reception of information. Indeed, there is a growing suspicion whether the very creation of such systems founded on strict

separation between syntactic and semantic aspects of communication is not responsible for the alarming failure to communicate. At any rate, it is increasingly becoming clear that there is perhaps more to the communicational process than mere transmission of symbols and their faithful reception. The word 'communication' is derived from the Latin word 'communicationem' which means sharing. And what is shared between whom, how and to what effect in a society is a complex function of the cultural, economic and political forces prevailing in that society. Any effort to treat a technology, information technology being no exception, in isolation from its context is misleading.

This growing suspicion over the present day approach to communicational process and its reductionist and isolative character prompted us to investigate the process of communication and to explore as to where the root of the problem of communication lies in the present time. This, in turn, necessiated an explication as to how various theories of communication are formulated in the contemporary time. The most important feature that these formulations seem to follow is that of reduction of the end to means - reduction of the world of values to the world of facts. Not surprisingly, 'medium becomes the message'. Manipulatable bits of information are taken as

stubborn facts while meanings are discarded as superfluous entities.

Above discussion suggests that it is necessary to develop an alternative epistemology in order to give a satisfactory account of the communicational process. To this end, an investigation into the nature of reality, its conception by the human mind, is taken up. This investigation suggests that the use of 'symbols' and 'categories' for the purpose of communication is unavoidable. For any meaningful communication to take place, a signification has to be generated which necessarily calls for categorisation. If that is so, it is of interest to examine the circumstances in which the use of symbols render the process of communication pathological and to what extent those circumstances obtain in contemporary information transmission systems. These above considerations lead us to plan the present thesis on the following lines.

In Chapter 2, a brief historical account of the approaches to the communicational process has been given. We point out that in modern times, a great effort is devoted to the means of communication while a correspondingly lesser attention is paid to the study of the theoretical aspects of communication. To exemplify this, we have critically analyzed Shannon's formu-

lation and pointed out its inadequacies to deal with the semantic and pragmatic aspects of communication. This is followed by an elucidation of semantic theory of information as suggested by authors like Bar-Hillel and Carnap. These formal theories are also found to be inadequate to deal with concepts like meaning, pragmatic use of symbols etc. In this context, we discuss the pragmatic theories of information proposed by Maekay, Cherry, Yovits etc. Some of these theories are found to be interesting and seem to provide certain important insights into the communication process. They, however, fail to give a satisfactory account of the concept of meaning arising in real life. Moreover, these theories do not take into consideration the multilevel complexities of context.

An alternative approach to communication has been developed in Chapter 3. To this end, we explore the nature of reality and its perception and comprehension by the human mind. We consider the use and scope of symbols for the purpose of communication. We provide a framework of analysis that allows for two types of communication-Symbolic and Imaginary. Imaginary communication is characterised by its closed formal structure and a misplaced attribution of ontological status to symbols.

In Chapter 4, we make a tentative attempt to formulate a concept of meaning as arising in human communicational process in the light of the alternative epistemology introduced in Chapter 3. We also seek the relationship between that concept and declarative and procedural types of knowledge. This account of meaning though by no means exhaustive, nevertheless, strives to keep in focus the enormous complexities of the communication process. Based on our account of meaning, we suggest a 'model' of communication that incorporates the features of levels, the active relational nature across and within the levels. It would appear that many of the existing models of communication considered in the earlier chapters can be subsumed within the framework of the 'model' suggested here.

CHAPTER 2

HISTORICAL ACCOUNT OF THE APPROACHES TO COMMUNICATIONAL PROCESS

2.0 Historical Development of Information Theory

> 'The past is always remembered, re-presented.... Time is lost and regained; it is subject, object and relationship in itself. Montaigne speaks of his past and past replies with advice about the future, for human time is not chronological but dialectical'.
>
> Wilden

Communication is as old as human society itself. It has often been emphasized that a society can be seen as people in communication. The process of successful communication involves both transmission and reception of symbols and a shared set of meanings for those symbols. Societies, in the past, were organized in such a way that people had rarely the need to extend their involvement beyond their communes or villages. Communication, therefore, was local and largely restricted to face-to-face (communication). It is not that in the past there were no elaborate systems created for communication over long distances. In the Roman empire, Ceaser (100-44 BC) for example, maintained, a wide network of couriers on horse-back or on carriers with relay posting stations at regular intervals along all the main roads. But such

instances were rare and limited only to monarchs who used them mainly for the purpose of control and administration of their empires. Although there presumably existed no pressing need to communicate over long distances, those early societies seem to be acquainted with some of the important notions of modern signal transmission systems. The use of signs and codes, for example, is of course very old. Not only the written languages, as codes to communicate over long distances, were developed thousands of years back, but Tyro, a Greek, in 60 BC evolved a workable system of shorthand for recording the speeches of Cicero. Congo tribes are known to have used 'talking drums' to communicate over long distances. They seem to have used two notes : 'male voice' and 'female voice' to imitate the human speech. In the 2nd century BC Polybius described an arrangement by which the whole Greek alphabet could be transmitted by fire signals using a two digit five level code. It is not very different from the Morse code with dashes and dots. These efforts, however, remained limited to few individuals and never quite became the pursuit of the society as a whole.

Moreover, as communication was limited to people within communes and villages, they shared the same cultural background-religious, social, political etc. and had similar perceptions and values. And within the framework of that

common context which alone imparts meanings to signs and symbols used, the second important aspect of communication - a shared set of meanings for the signs and symbols - was readily achieved.

With industrialization characterised by an undue emphasis on men's mastery over Nature, there came about significant changes in the organization of the societies. The percieved need for planned industrial and economic growth called for a wide search for both raw materials and new markets on an unprecedented scale. This led to world wide explorations and migrations. It is believed that it is this search for raw materials and new markets that underlies the phenomena of colonization and the two world wars . All these called for immence amount of exchange, control and administration of information[1]. In the modern industrial society, people are continuously uprooted and centralized planning, control and administration on a mass scale over all activites of human life - social, political, economical - have become a regular feature. The desire for communication has grown in proportion to the failure

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1. A typical example of this is the Telegraph. Telegraph was used in 1851, between London and Paris, for the first time, so that prices could be compared rapidly during the year of great exhibition. Atlantic was crossed in 1866 and by 1871, the first connection to India was made (1) to help speedily suppress uprisings like the one in 1851.

to establish communication. So much so, in contemporary societies, the amount of information consumed has come to be regarded, both by the rulers and the ruled, as an index of progress.

The growing desire for communication has created problems both as to the means of communication (transmission and reception of signals) as well as to those related to 'meaning'. As the new situation involved mutlitudes of men ever on the move and with widely differing cultural backgrounds, perceptions and values, successful communication depended as much on creating conditions conducive to acquiring shared sets of meanings as on providing increased means of communication.

However, historically, almost all efforts were directed only to developing varied and extensive means of communication. Communication theorists have either largely ignored the question of meaning or have considered that meaning can be assimilated to the means of communication.

Not suprisingly, development theorists have taken, it upon themselves to advocate the view that 'medium is the message'.

Development of modern systems of communication can be traced back to Roger Bacon. Roger Bacon, in 1267, suggested

that the 'sympathetic' movements of magnetic needles can be used for telecommunication. Watson sent electrical signals over two miles of wire as early as 1746. In 1753, one wire for each letter of the alphabet was used by an anonymous worker. This was improved upon by Lomond, in 1787, who used a wire pair and a code. The first practical trials of telegraph were made by railways in 1837. Simultaneous transmission of many signals over a 'carrier wave' was made feasible by Campbell's invention of 'wave filter' during the first world war.

An important break through was achieved by Graham Bell. In 1876, he invented the telephone which enhanced the possibilities of direct communication i.e., without the use of codes. Marconi's discovery of wireless (1909) made it possible to transmit and receive messages through the space. This was followed by the invention of television during 1925-27.

By 1920's (especially during and after world war I), a large number of diverse communication systems were developed. Efforts were made to compare the performance of different systems of communication. This led to a search for developing objective (mathematical) criteria to compare these system.

The first attempt in this direction seems to have been made by Nyquist (Nyquist H., 1924). Nyquist in his paper entitled 'Certain Factors Affecting Telegraph Speed' introduces, among other things, the relationship between the speed at which 'intelligence' can be transmitted over a telegraph circuit with a given line speed, i.e., a given rate of sending of signal elements. He derived the relation (assumptions underlying this relation are given in Appendix B of his paper).

$$W = k \log m \qquad (2.1.1)$$

where W represents the speed of transmission of intelligences, k is a constant and m is the number of different current values available.

The seond important contribution in this direction came from Hartley in 1928. His famous paper 'Transmission of Information' used the notion of 'Information' for the first time and defined it with respect to the source. It introduced the notion of a message sender having a set of symbols out of which it chooses one after another and thus transmits a sequence of symbols. The quantitative expression for 'Information' (devoid of psychological factors) of a message is defined as the logarithm of the number of possible sequences of symbols and is given by

$$H = n \log s \qquad (2.1.2)$$

where, n is the number of selections and s is the number of possible symbols available at each selection and H is the quantitative measure of 'Information' contained in the sequence of n symbols. Information, in this definition, is thought of as a reduction in doubt, and is therefore, measured in terms of a function of number of choices available. The term 'Information', as defined is not concerned with the semantic aspects of the message. Hartley was aware of the ambiguities of the term 'Information' and maintained that 'as commonly used, information is a very elastic term and it will first be necessary to set up for it a more specific meaning as applied to the present discussion'. (Hartley : p. 536). And he considered that 'it is desirable therefore to eliminate the psychological factors involved and to establish a measure of information in terms of pure physical quantities'. (Hartley: p. 536).

Hartley's quantitative measure of information forms the basis of later developments in 'Information Theory'. Shannon in 1948 (Shannon, 1948) employed the conceptual tools, developed by Hartley and Wiener, to study the transmission of signals whose occurences were given only in statistical terms. This gave rise to 'The statistical Theory of Communication'. As Shannon makes it clear, the purpose of his paper was to extend the theory to include a number of new factors, in parti-

cular, the effect of noise in the channel, and the savings possible due to the statistical structure of the original message and due to the nature of the final destination of the information' (Shannon and Weaver 1949). Mathematical theory of communication 'provides the most general conceptual framework known within which to study efficient and reliable communication because of the joint emphasis on the encoder and decoder and the freedom from restrictions to particular types of receiver structures' (Galleger . p.12).

Even though Shannon mainly developed the concepts proposed by Hartley and Wiener, his paper is taken as a hallmark in the field of 'Information Theory', due to its comprehensiveness and applicability to a very large number of situations in electrical communication systems. Application of these concepts to Markov processes made it more readily acceptable for telegraphic code designs as Markov process is claimed to be a good approximation to natural languages like English where letters of the alphabet are taken as the basic units. Shannon's channel capacity theorem had a considerable impact on the later development of coding schemes for signal transmission.

Many of the later developments in Information Theory are based on the conceptual framework provided by Shannon. There

have been many unsuccessful attempts to apply this theory to the fields of psychology, economics, management, linguistics, etc. Some of the important contributions to 'Information Theory' made by authors like Bar-Hillel, Dretske, Yovits etc. are discussed in section 2.3.

2.1 Conceptual Formulation of Information Theory

With the historical information given in section 2.0, we now wish to analyse the conceptual framework of 'Information Theory'. It is appropriate to point out here the motivation behind our attempts to carry out such an analysis. We are concerned with the adequacy of 'Information Theory' as a formal system to provide an account of the diverse communicational process as encountered in real life. The mathematical and other details within the system of information theory are therefore, not of immediate interest to us.

Nyquist considered the fundamental factors entering into the maximum speed of transmission of intelligence by Telegraph. By the speed of transmission of intelligence is meant the number of characters representing different letters figures etc., which can be transmitted in a given length of time assuming that the circuit transmits a given number of signal elements per unit time.

The factors, accordingly to Nyquist, affecting telegraph speed are signal shaping and choice of codes. The first is concerned with the best waveshape to be impressed on the transmitting medium so as to permit greater speed without undue interference either in the circuit under consideration or in those adjacent, while the later deals with the choice of codes which will permit transmitting a maximum amount of intelligence with a given number of signal elements.

It is interesting to observe that Nyquist did not use the word 'Information' or 'Information Theory' in his work. However, the two concepts, maximum speed of transmission of intelligence and the choice of codes runs through the whole development of information theory.

Hartley introduced, for the first time, a quantitative measure of 'Information' which is based on physical as contrasted with psychological considerations. His contribution may be summed up as setting up a quantitative measure for comparing the capacities of various systems to transmit information. This measure has been shown to be the product of the width of the frequency range over which steady state alternating currents are transmitted with sensibly uniform efficiency and the time during which the system is available.

Hartley, essentially, defined the number of simultaneous messages that could be transmitted by a signal as the 'quantity of Information'. He suggests that the 'quantity of information' contained in a message selected out of n possibilities is given by $\log_2 n$. If that be the case, it is clear that this concept of information is connected only with the number of possibilities - number of possible messages - and not with their content or meaning. Therefore, it is essentially a 'Theory of signal transmission' and not a 'Theory of Information', if the term 'Information' is to subsume the notions of meaning in it. Hartley himself pointed out that 'as commonly used, information is a very elastic term, and it will first be necessary to setup for it a more specific meaning as applied to the present discussion', (Hartley : P. 536). He concludes that 'it is desirable therefore to eliminate the psychological factors involved and to establish a measure in terms of purely physical quantities' (Hartley : p. 536). It might be added that' not only psychological but also semantic factors are eliminated by the process envisaged by Hartley' (Bar-Hillel : p. 283). We shall discuss the implications of this reduction at a later stage where we explore the adequacy of 'Information Theory' to provide an account of the process of communication in real life.

As applied to a continuous signal band limited to FHz and having N quantization levels, the total 'amount of information' associated with a signal of time length T seconds is given by $\log_2 N^{2FT}$ and is obtained through the following argument. Since the signal is sampled at a rate of 2F samples per second, total number of samples in T seconds is 2FT and, since there are N possible levels at each sample, total number of possibilities is N^{2FT}. If all the possibilities are assumed to be equally probable, the amount of information associated with each of these signals is $\log N^{2FT}$. It is important to note here that following assumptions are made 1) a continuous signal can be specified by N quantized levels due to some constraints in the physical signals, 2) the signals are independent of each other, 3) all signal sequences are equally probable.

The extension of the above measure of information to the case when N is not a power of 2 can be obtained easily but this will require an additional assumption of the measure being an average property (Cherry : pp 175-179). Also the measure can be extended to the case where signal sequences occur with unequal probabilities p_i. These extensions essentially lead to Shannon's measure of information for discrete signal sources. At this stage it is appropriate to see how 'quantity of infor-

mation' is (or is argued to be) related to uncertainty and doubt and therefore to entropy. The argument goes as follows :

Information can be received only when there is doubt; and doubt implies existence of a situation where choice (selection or discrimination) is called for. In the process of communication, one transmits signals which are the physical embodiment of message. When one says that signals 'conveys' information what it means is that 'the signals have information by virtue of their potential for making selection' (Cherry : p. 169). Signals operate upon the recepients doubt; they give the power to discriminate among these alternatives. It is plausible, therefore, to talk of information contained in a signal as some function of reduction in doubt, in uncertainity over the possible alternatives.[1] If the signal being selected out of n possibilities (with $p_i = \frac{1}{n}$), for example, the reduction in uncertainity is n and the information measure will be given by some function of n. The choice of logrithmic function is made for certain additional practical constraints.

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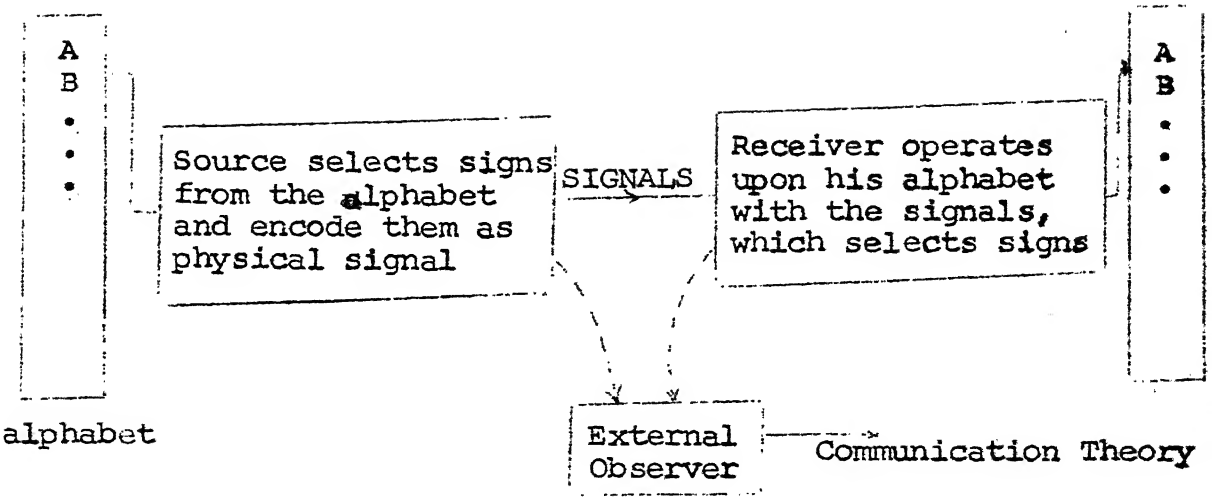
1. The shift from the 'reduction of doubts' as one of the factors involved in the notion of 'Information' to its being the only factor is important to note.



Once the identification of our richer common-sense notion of information with statistical uncertainity is accepted, one is on the secure soil of calculus of probabilities. Thus, for example consider a hypothetical statistically stationary source emitting a sequence of independent signals with unequal probabilities of occurence. Then an average measure for the 'quantity of Information' of the source can easily be obtained as follows.

In an extremely long sequence of signals, each signal in it will occur with almost their estimated probabilities. Consider n different possible signal sequences, each of s signals in length. In case of sufficiently long sequences, these sequences differ only in the different order of occurrences of signals. Then all such long sequences will have nearly equal

probabilities p(s) of occurrence p(s), therefore, will be given by $\frac{1}{n}$. Furthermore,

$$p(s)=\pi\ p_i^{sp_i}$$

as the signals are independent. Information of each (equally likely) sequence chosen out of n possibilities, therefore, is given by

$$H(s) = \log_2 n = \log \frac{1}{p(s)}$$

The average amount information per signal is defined as

$$H(i) = \frac{H(s)}{s} = \frac{1}{s} \log \frac{1}{p(s)} = - \Sigma\ p_i \log p_i$$

which is same as the expression proposed by Shannon.

Shannom arrived at the same expression for 'average quantity of information' through a different path. Shannon[1] considered a discrete source with a set of possible events $(e_1, e_2, \ldots e_n)$, with the probabilities of occurrence $p_1, p_2 \ldots p_n$. He then posed the question 'can we find a measure of how much of choice is involved in the selection of the event or of how certain are we of the outcomes?' (Shannon

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1. This analysis is mainly derived from Shannon's 'The mathematical theory of communication', (1948).

and Weaver : p. 18)[1]. He stipulated that such a measure $H(p_1, p_2 \ldots p_n)$ should satisfy the following conditions.

1. H should be continuous in p_i's
2. If all p_i's are equal, $p_i = \frac{1}{n}$, then H should be a monotonically increasing function of n.
3. If choices are broken down into two successive choices, the original H should be a weighted sum of the individual values of H i.e., the function H should be additive according to this condition, for example

$$H(x,y) = H(x) + H(y)$$

where events x and y are independent/ the only expression satisfying these properties is shown to be given by

$$H = - K \Sigma p_i \log p_i$$

where K is constant depending on the unit of information chosen.

This expression H has been identified as entropy by Shannon, borrowing the terminology from the statistical thermo dynamics[2]. It is a characteristic of the source. It is impor-

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1. It should be noted that the question itself is loaded with a bias that it is the choice or uncertainity that we are concerned with; and it is this uncertainty that defines information.

2. In statistical mechanics, the famous Boltzman's theorem states that $H = -E\, p_i \log p_i$, where p_i is the probability of a system being in a cell i of its phase space and H is the entropy of the overall system.

tant to note that H is the measure that depends only on the probabilities p_i's of the events. The events themselves are unimportant and their content contributes nothing to the information measure. Joint entropies and conditional entropies also in the above formulation, can be developed in a similar manner but we will not go into those details.

In case of continuous sources, expression for entropy and hence' 'quantity of information' is obtained by analogy. The important difference to note between the two cases is that entropy in the discrete case is always a finite quantity whereas that in the continuous case can go to infinity.

2.3 Later developments in Information Theory

> 'Scientific controversies constantly resolve themselves into difference about the meaning of words'.
>
> Prof. A. Schusten

In the foregoing section we have sought to explicate the historical background of Information Theory and thereby provided a conceptual formulation for the same. Although Information Theory seems to provide some meaningful account of the concept of information, a moment of reflection leaves one

with a sense of discontentment and dissatisfaction. A closer look at the causes of dissatisfaction discloses that one of the important reasons lie in our expectation that this formulation should comprehend our common sense notion of information. Therefore an explication of the common sense notion of information becomes necessary.

The concept 'Information' in its general usage[1] seems to be a vague and elusive one. However, much effort has been made to describe this concept. A casual description may suggest that information is something which flows on a process that makes communication possible. Further, it may be noted that information of a message is said to be what is conveyed by the message. As Dretske says, one thinks of information as 'what is capable of yielding knowledge, what information a signal carries is what we can learn from it' (Dretske P. 44). He further adds 'since knowledge requires truth, information requires it also' (Dretske p. 45). A pedantic view on the notion of information speaks of it as useful information, valuable information, reliable information, true information and the like.

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1. To differentiate between the notion of 'information' in general use and that envisaged in information1Theory we use terms information2 for the former and information for the latter.

We may also note here that information is felt to be a commodity that can be transmitted, received, exchanged, stored, lost, bought and sold. These varieties of ways in which information 1 is talked about, however, suggest that these seem to be an extremely large number of aspects involved in this concept, which particular aspect of the concept we will be interested in, nevertheless depends upon the context in which we talk about information.

For the purpose of discussion in the chapter, we tentatively propose, as a guideline, that the amount of information and information content of a message is how much and what meaning we are able to create out of it. However, this proposition is subject to modifications if necessary. The two terms that may be noted here are 'meaning' and 'able to create'. It may look like placing an elusive concept in terms of a few vague concepts. The notion of meaning and its creation by the human mind is explicated in Chapter 4.

In light of the multifacets of the concept of Information 1 as suggested above, let us critically examine the later developments on the concept of information 2 for the purpose of understanding different aspects of the concept Information 1 being covered by them.

The first question that was posed systematically upon the notion of Information 2 is q whether it deals with the semantic content of the message or not. The answer to the above question when considered in terms of its direct application to language was given in the negative. Information theory as such concerns itself with signs themselves and not with their designata[1]. For example 'Man bites dog' contains more information than 'Dog bites man' (as the former is less probable to occur compared to the latter) which is quite contrary to what one would achieve semantically. This may lead to the conclusion that 'information theory' is unable to provide any insight into the semantic aspect of information. A careful look at the conceptual formulation of Information Theory, however, discloses the contrary.

Bar-hillel suggested that the information calculus that underlies the formulation of 'Information Theory' could very well be used to develop the theory of semantic content of Information. As Bar-Hillel puts it, all that is required is a new information. He, thereby, developed a theory of semantic

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1. 'There is no logical connection whatsoever between these measures, i.e. the amount of (semantic) information conveyed by a statement and the measure of rarity of kinds simbolls sequences ...'

Bar-Hillel p. 236).

information based on this new interpretation. We should take note of the fact that semantics here does not refer to the concept of 'meaning' in our general use but only to 'meaning' as abstracted from the context except the one provided by its logicomathematical framework. Bar Hillel himself clarifies that he is talking 'about the information carried by a sentence, both by itself and relative to some other sentence or set of sentences, but not about the information which the sender intended to convey by transmitting a certain message nor about the information a receiver obtained from this message' (Bar-Hillel p.223) semantics in this case is defined as the information carried by sentences in a language system which essentially is a closed formal system[1]. This theory for the above purpose assumes an ideal set of transmitter and receiver or as he himself puts it' superhuman fictitious intellect ... with a perfect memory who 'knows' all of logic and mathematics, and together with any class of empirical sentences, all of their logical consequences' (Bar-Hillel p. 224). It is with the above mentioned limitations that this theory is developed.

As Bar-Hillel states, both the 'theory of signal transmission' developed by Shannon (Information Theory) and

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1. 'applied first order language system with identify' (Bar-Hillel p. 299)

'theory of Semantic Content' developed by him, can be regarded as different interpretation of a common formal system, the 'calculus of Information' (Bar-Hillel p. 291). In a simplified form, the calculus of information can be stated as follows.

Let $S = (s_1, s_2, \ldots s_n)$ and $R = (r_1, \ldots r_m)$ be two sets of numbers such that $\sum_n s_i = 1$, and $\sum_m r_j = 1$. (2.3.1)

and $f(s_i, r_j)$ and $g(s_i, r_j)$ be two functions each of two variable, defined over the set S and R respectively, such that

$$\sum_{j=1}^{m} f(s_i, r_j) = s_i \text{ and } \sum_n g(s_i, r_j) = r_j \quad (2.3.2)$$

In this calculus, the properties and relations of negative logrithms of the number s_i, r_j, $f(s_i, r_j)$ and $g(s_i, r_j)$ and their weighted averages such as $-\Sigma s_i \log s_i$ etc., of the limits to which these means tend, when either n or m or both tend to infinity etc. are discussed.

It is obvious that Information Theory uses this calculus with assignment of s_i as probability of transmission of i the event (p_i), r_j the probability of reception of j th event $f(s_i, r_j)$ and $g(s_i, r_j)$ as certain conditional probabilities.

According to Bar-Hillel, the same calculus with the following interpretation, forms the basis of his 'Theory of Semantic Content'.

> Let H = $h_1, h_2, \ldots h_n$ and K = $k_1, \ldots k_n$ be exhausive systems of events (for a given evidence e) i.e. systems of events such that (on the given evidence e) exactly one of the n h_i and one of the m k_i must occure .. s_i is interpreted as the degree of confirmation (or inductive or logical probabilities)[1] of the events h_i on the evidence e and the r, as the degree of information of the events k_j one, - log s_i in this case may be taken as a measure of (atleast a certain aspects) the content of h_i, $\Sigma - s_i \log s_i$ as measure of average content of the event h_i etc'. (Bar Hillel p. 292).

Bar-Hillel has developed a detailed semantic theory in his paper an outline of a theory of semantic (Bar Hillel : p. 221-274). Here he makes note of the fact that 'in most cases' of application of 'Information Theory' into the field of psy-

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1. Logical probability is different from statistical probability applies to classes of things but an inductive probability applies to pairs of statements, the hypothesis and the evidence. Inductive probability in contrast to statistical probability is'not a physical property of a thing or a system but is a relation between a hypothesis and some evidence, the latter usually expressing someones knowledge.'

   (Cherry p. 233)

chology, linguistics economics etc.' it is rather the information calculus that is applied and not at all its communication engineering application'. (Bar Hillel : p. 292).

It may be of wonder that Weaver's hope that 'Information and meaning may prove to be something like a pair of cannonically conjugated variable in quantum theory' has almost come true. But a closer look at Bar-Hillel Sematic theory discloses that there is nothing so wonderous about it. Semantics as used in this formulation is a concept abstracted from all specific human users and from all specific situation. This concept of semantic is therefore not the same as that Weaver talked about. 'the concept of semantic information' notes Bar-Hillel, ' has nothing to do with communication' (Bar-Hillel p. 287). Secondly this is defined within a language system which is essentially a closed formal system and where all the signs and their meanings' are fixed and predefined. It is, therefore, very natural for this concept to yield to a mathematical formulation like 'information calculus'. This concept when applied to a simple real life conversation like 'we shall go according to our fixed plan', declares that this (if at all it can deal with it) sentences has got the same amount of information for all receivers irrespective of their knowing the plan fixed earlier. Moreover, it can't deal with

any new situation e.g. it can not talk of a word like 'unask', which is not predefined in the language system, not to talk of its incapability to deal with the following piece from Lewis Carrol.

> ' Who did you pass on the road?' the king went on ...
> 'Nobody', said the Messenger
> 'Quite right', said the King : 'this young lady saw him too. so ofcourse
> Nobody walks slower than you'
> 'I do my best', the messenger said in a sullen tone.'I am sure nobody walks much faster than I do!'
> 'He can't do that', said the King, 'or else he'd have been here first .....'
>
> (Lewis Carrol : p 282)

A careful examination into this theory, then, raises serious doubts if it comprehends any significant aspect of information 1. Ten years after the publication of his paper on Semantic Theory of information, Bar-Hillel, while delivering a series of lectures on Algebraic Linguistics and Machine Translation noted. 'Let nobody be deceived by the term 'machine language' ... Surely computers can manipulate symbols if given the proper instructions and they do it splendidly, but the distance between symbol manipulation to linguistic understanding is enormous and loose talk will not diminish it' (Bar Hillel : 214), and further, 'Autonomous, high quality machine translation between natural languages according to rigid algorithm may

safely be considered as dead' (Bar-Hillel : p. 218). Such translation on the basis of learning ability is still-born'. (Bar-Hillel : p. 218). The situation does not seem to have improved very much. We can refer to 'SCHRODLO' programme discussed by Hofstadter(Hofstadter:PP 586:593). Consequently, one is left with the same feeling of discontent. Let us, then, have a look at yet another formulation of Semantic information.

Dretske, while developing the semantic theory of information, differentiates between the 'amount of information' and 'information content'. According to him, the first answers the question how much of information while the second 'what information?'. Since information is contained in particular messages and there is no sense of talking of average information content over messages, it is necessary to define the amount of information associated with individual messages. He defines the amount of information associated with individual message s_a by

$$I(s_a) = - \log p(s_a) \qquad (2.3.4)$$

where $S = s_1 \ldots s_n$ is the set of messages with the probability assignment $p = p_1, \ldots p_n$ only. Unlike Information Theory this concept plays an important role in his formulation. Other

important expressions (for particular messages) are developed analogous to information theory but with necessary modifications. The amount of information received is defined as

$$I_{s_a}(r_a) = I(s_a) - E(r_a) \qquad (2.3.5)$$

where $E(r_a)$ is the equivocation associated with the reception of message r_a[1].

While defining $I(s_a)$, (amount of information) Dretske is aware that 'if one seeks an absolute measure ... for the amount of information generated by an event ... one must be in position to determine the range of possibilities and their associated probabilities' (Dretske, p. 54), whereas 'there may be no well defined range of alternative possibilities in terms of which this figure could be calculated' (Dretske, p. 54) and that we can 'only make clumsy guesses about the amount of information (Dretske p. 54). This essentially is the situation in real life communication.

Despite these limitations, these expressions, for I_{s_a} and $I(r_a)$ are useful especially in the sense of making 'comparision between the amount of information generated

---

1. 'Equivocation $E(r_a)$ is function of how we specify the possibilities at the source. It is relative to how we describe the event at the source about which information is being transmitted and is always positive. The amount of information that a signal carries about a source sets an upper bound on what information a signal can carry about the source'.

at the source by the occurrence of an event and the information that the signal carries about the event' (Dretske : p. 54). In fact, in his later analysis, it is this relative measure which recurs frequently.

Without entering into the details, we shall state the definition of 'information content' as proposal by Dretske

> A signal r carries the information that s is F = The conditional probability of S's being F given r (and k) is 1 (but given k alone, less than 1) (Dretske p. 65).

k stands for previous knowledge of the receiver about the probabilities that exists at the source. This definition deals with the 'signals de re informational content, a content that might be expressed by saying that r carries the information of or about S that it is F. What is essential to the information is the relation between (... is F) and some individuals. What description phrases we use to describe the individual; is irrelevent. For example a sentence 'My grandmother is smiling' contains the information that someone (who happened to be my grandmother) is smiling. It is not her being my grandmother or the way I recognise her but the fact that she is smilling which is important to this definition.

The sense in which Dretske uses 'information Content' may become a little clear from his statements such as 'Roughly speaking, information is that commodity capable of yielding knowledge and what information a signal carrier is what we can learn from it' (Dretske p. 44). Also, '... information is what is capable of yielding knowledge and since knowledge requires truth, information requires it also' (Dretske p. 45) This seems to be a fairly wide interpretation of the term information and does have a promise atleast for the case of propositional knowledge . Introduction of the variable k has an important function of introducing the previous knowledge of the receiver and thereby his past history in the picture. Moreover through the consideration as to what information is analytically or nomically contained in the information that s is F, the question of intentionality comes into focus 'If a signal carries the information that S is F, it does not necessarily carry the information that S is F despite the extensional equivalence of 'F' and 'G'. (Dretske p. 75). This is to say that even if 'F' and 'G' are true of exactly the same thing (have the same extension), the information that S is F is different from the information that S is G. (This concept of intensionality will be of use when

we discuss the concept of meaning). Dretske's formulation appears to be the most general approach to the semantic aspect of information proposed so far. It concerns itself with the state of knowledge of the receiver and also clarifies the issue of intentionality. This theory, to a great extent, talks of information content in the light of the context the information is embedded into. According to this formulation, for example, a sentence, 'we shall go according to our fixed plan' will have different information for receivers with different state of knowledge. Similarly, while taking intentionality into account, In, a sentence 'It is a square' need not contain the information that 'It is a rectangle' if the receiver does not have the concept of 'rectangleness' vested within the concept of 'squareness'. This theory, with all its generalization at the semantic level, is nevertheless limited to propositional knowledge system[1]. It is moreover unable to deal with the questions of pragmatic and that of the real context. For example, it is not able to tell us anything about whether the information content of this sentence 'we shall go according to our plan' is of any use to receiver or whether the receiver finds its reliable or not. Further, it is not in a position to define --------

the information content of an instruction on how to ride a bicycle, (a non-propositonal knowledge). To illustrate its capability (or incapability) to deal with real context, take the following example of a conversation between two communicants A and B.

A : Please give me a glass of water

B : (Hands the water to A)

A : Thank you.

First of all, it is doubtful if one can talk of semantic content of such sentences in the given analysis as they don't fall into the category of propositional knowledge. But even if one can, the first glance will suggest that B is dominant over A as A is requesting B for a glass of water. But a moments reflection with a different perspective of A's first message as a command, it is discovered that A is dominant throughout. However, their relationship could be mutual or pseudo-mutual or any number of things. This theory, then, finally leaves us with a sense of incompleteness, and therefore, necesitates a further exploration.

Having discussed the two important formulations of Semantic content of information 1 and taking note of their limitations to encompass this notion of information 1, we shall now study some of the efforts made in order to improve upon the

situation by considering the pragmatic aspect of information.

Authors like Mackey, Cherry, Bongard, Yovits etc. have tried to extend the concept of information to cover the pragmatic aspect while preserving the formal structure and the basic notions-'Information' of a message is defined as a reduction in uncertainty - of 'information Theory'. They have applied this notion to a variety of complex problems such as detection, decision making, recognition etc. The function they use to relate uncertainty to probability distributions of the messages differ with regard to different authors in different situations. We shall attempt to touch upon the formulations by Mackay and Cherry while discussing in brief those of Yovits and Bongard.

Information for the above authors, is defined at its pragmatic level i.e., at the level of its use value. A common assumption shared by them (and which is made explicit by Youits in his paper 'Development of a theory of Information Flow and Analysis' is that effects of information on a receiver are available in terms of the observables which can be measured.

Mackay defines the value of any message to be logarithm of the ratio of performance of the system after and before the receipt of the messages. How one defines system performance is however left open by Mackay.

According to Cherry, information helps the Decision maker in narrowing the range of his hypothesis i.e. it reduces decision makers' uncertainty by narrowing his range of viable alternatives. Information, therefore, may be defined as the logarithm of the ratio of posterior and apriori probabilities of selecting an alternative and is based upon Bayes theorem.

$$\text{Amount of Information} = \log_{10} \frac{P_i \text{ posterior}}{P_i \text{ apriori}}$$

Yovits defines measures for both 'the amount of information' and 'value of information' in Decision Making situations modelled by the following structure :

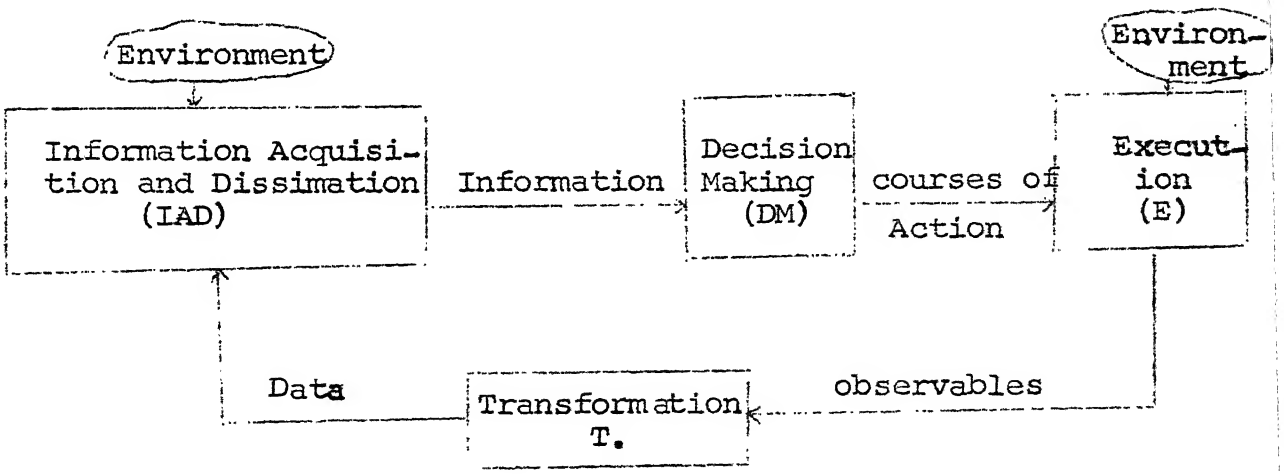


Figure The Generalised Information System Model

One of the three basic hypothesis made by Yovits, is that Information gives rise to observable effects. The other hypothesis

asserts the presence of feedback for later decisions. The objective of decision making includes in addition to classical objective of the best course of action, the aim of learning more about the total existing situation through the Decision Making process. The second objective is included to take care of uncertainties in the outcome (relational and structural) and also of the dynamic nature of the process.

Three types of uncertainties which are recognised and are dealt with are natural (number of states of nature), executional (as to which course of action (c.o.a) results into which outcome) and goal (value of the outcome so reached).

With this foundation, measures are developed for a particular state of nature. Matrices W and V are defined for executional and goal uncertainty.

w_{ij} = estimated probability that ith c.o.a. results into jth outcome

w_{ij}^* = actual probability that ith c.o.a. result into jth outcome.

v_{ij} = estimated value of outcome j as a result of execution of ith c.o.a.

$v_{ij}^* = v_{ij}$ (assumed)

Expected value of each c.o.a. is defined as

$$EV_i = \Sigma\ w_{ij}\ v_{ij}$$

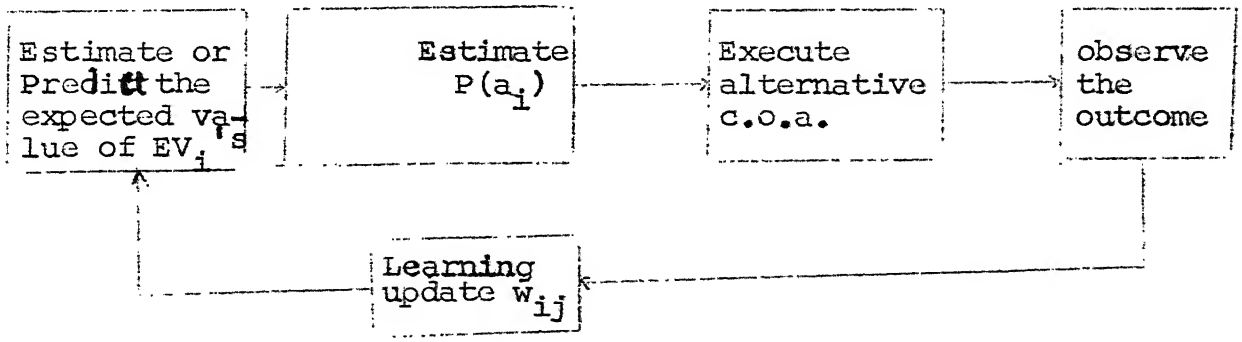
EV_i 0 (assumed) for mathematical simplicity. It may, however, be negative also.

A decision in the classical case would have meant choosing i over j, if EV_i EV_j. But due to the second objective as mentioned, only a probability measure can be defined for such selection. The probability measure $P(a_i)$ has to satisfy certain basic conditions of the measure along with the condition that in case of no confidence of Decision Maker (DM) in his knowledge of EV_i's, every $P(a_i)$ will be assigned a value $\frac{1}{n}$, and in case of full confidence, $P(a_i)$ will be 1 for maximum EV_i. a measure under such conditions is defined and is given by

$$P(a_i) = \frac{(EV_i)^c}{\Sigma(EV_i)^c}$$

where c is the confidence factor of the DM.

The Decision Making process is represented by the following



After each observation, EV_i is revaluated by the learning rulle

$$EV_k\ (t+1) = (1-\lambda_k(t))\ \ EV_k(t) + \lambda_k(t)\ V_k(t)$$

where $V_k(t)$ is the actual value resulting at time t due to kth c.o.a. and $\lambda_k(t)$ is learning function given by

$$\lambda_k(t) = \frac{1}{(c_k+1)\ \text{x number of trials for c.o.a. k}}$$

c_k is the degree of confidence.

There is no learning if c_k tends to infinity and high learning when no confidence ($c_k = 0$). c_k is the degree of confidence.

Information, in this formulation, and at its pragmatic level, is defined as the reduction in uncertainty of the Decision Makers' choice of action. This choice is realted to the probability $P(a_i)$'s. It is, therefore, plausible, to think of variance of $P(a_i)$ as a basic measure of information. The measure of information satisfying some fundamental properties of measure, is given by

$$I = \frac{\sigma^2(p)}{\mu^2(p)} = \frac{\Sigma[P(a_i) - \mu(p)\ ]^2/m}{\mu(p)^2} = m\Sigma P(a_i)^2 - 1$$

It should be noted here that value of I is 0 if all $P(a_i)$'s are

equal, and is m-1 if $P(a_i) = 1$ for i and 0 for others. In case of m = 2, I = 1, that is, in binary choice case I = 1, so the unit of I can be defined as binary choice unit (b.c.u.).

Under these definitions, amount of information in a data is defined as difference in information before and after the data is received.

$$I(D) = I_{t+1} - I_t.$$

The value of information of a data is defined in terms of the capability of a Decision Maker to achieve his goal - Decision Maker's Effectiveness - after and before the data is received.

$$Q(D) = DME_{t+1} - DME_t$$

DME in turn is defined by

$$DME = \frac{AP}{\text{Max } EV_i^*} = \frac{\Sigma\, P(a_i)\, EV_i^*}{\text{Max } EV_i^*}$$

This formulation considers a very general case of Decision Making. However, the effects of information may not be available in terms of observable in many cases. The three uncertainties - natural, executional and goal implies a very general case of decision making. These three types of uncertainties

reoccur in case of Human processing structure (Schroder 1967) with some modifications. The system is kept open to external environment through the variables such as v_{ij}, c, c_k the natural and executional uncertainty (structural-numbers of possible c.o.a. and of possible outcomes.). It should be noted here that v_{ij} and w_{ij} are totally interchangeable. It is possible, therefore, to keep it open through relational executional uncertainty as well.

The value of I(D) varies from -1 to 1, the negative values pointing towards the fact that uncertainty may get enhanced by a new data. The measure defined here is a function of time, of Decision Maker's confidence, of different decision making situations etc. It is, therefore, to a large extent a contextual measure. This formulation may be of help when we discuss the Human processing structure in Chapter IV.

Another measure of information, developed by Bongard, takes into account the usefulness of the information to the receiver. Inadequacy of the classical measures proposed by Shannon to deal with the concept of information in terms of its usefulness to the receiver led Bongard to propose a measure of information which, as he claims, takes care of the issues such as the relevance of the message to the receiver, capacity of the receiver to decode, receiver's previous knowledge etc.

However, the essential argument that the information is related to reduction of uncertainty remains unaltered. In that sense Bongard's measure of information is a generalisation of the classical measure of information due to Shannon.

Bongard defined information content in a signal as

$$I = N_o - N_1$$

where, N_o and N_1 are uncertainties in the process before and after the signal arrival respectively.

Let p_i's be the probabilities associated with events and q_i's the initial estimate of p_i's (receiver knowledge), then the total uncertainty is given by

$$N_1 = - \sum_{i=1}^{M} p_i \log q_i = N(\underline{p}/\underline{q})$$

which under the condition of $p_i = q_i$ reduces to

$$H(\underline{p}) = - \Sigma\, p_i \log p_i$$

which is Shannon's measure of information. In a similar fashion we can also show that channel capacity defined by Shannon is a particular case of that due to Bongard.

In short Bongard's measure of information depends upon i) recepients knowledge of p_i's, ii) the prior knowledge of the receiver and iii) the information of the message through the channel, received for the adaptive process. However, the situation changes sufficiently when the system with feedback is considered [illegible]. The statistical methods no more hold good. After every trial in this case one of the alternatives is totally eliminated and the next most possible alternative is tried by assigning a probability of 1 to it.

The measure does introduce some of the very important issues involved in human communication and highlights some of the assumptions made by the mathematical theory of communication. However, it has its own limitation in relation to human communication process. Chapter 4 will amply demonstrate this fact. It is sufficient to mention here that the learning process described above assumes a static model of decoding device (except in the feedback case) and performance criterion is assumed fixed for comparing different decoding devices. Whereas, those aspects are dynamic in nature in human communication systems.

Having discussed the important aspects of different formulation of concept of information 1, let us take stock of

the position so far reached in this chapter.

Information theory deals with the abstracted syntactical aspects (concerned with signs, symbols devoid of meaning and real context, and their relations). It is apparent that the hopes of authors like Weaver that the syntactic level 'overlaps more than one could possibly naivly suspect' (Shannon & Weaver : p. 98) and that ' the interrelation of the three levels is so considerable that one's final conclusion may be that separation into three levels is really artificial and undesirable' (Shannon and Weaver : p. 114), have been unrealistic ones. Wiener's opinion that 'the amount of meaning can be measured. It turns out that the less probable a message is, the more meaning it carries, which is entirely reasonable from the standpoint of common sense'. (Weiner : p.8) turns out to be altogether wrong. This gap between concept of information 1 and that of information 2 was, however, realized by the founders of information theories like Hartley and Shannon.

At this stage it appears that it is the formal structure of these theories that makes them incapable of dealing with the real life situations. These formulations are useful only when embedded into a real life context with

care taken to see that the abstraction at this level of formulation is not carried over to the formulation of the content itself. The pragmatic theories, to the extent they keep themselves open to the context, are able to approximate the real life situation in a meaningful way. These theories are developed for specific context, say decision making, recognition problem etc. and they keep themselves open to the higher levels of context(and thereby to 'purpose' and 'goal seeking') by introducing variables such as value function, confidence level, costs and the like. ... Care must be taken that these variables are assigned from outside that is, they are over-determining factors. But to that extent, they fail to provide a precise rigorous and universal way of going about things while keeping within the system.

These above considerations make one to observe certain trends in this development. As we proximate more and more towards the concrete situations, the rigorous and formal structuring of formulation has to be weakened and the system needs to be made open to the environment ie., to the context in which it is embedded. One may doubt whether it is in the very nature of formal systems that they fail to comprehend the reality and whether it is in the very nature of reality

that it transcends every effort of formalization - especially a formulation in terms of a rigid closed system. We shall take up, for further discussion and elucidation, these characteristics of reality and its relation to formal systems in the next chapter.

CHAPTER 3

AN ALTERNATIVE EPISTEMOLOGY

Our analysis in Chapter 2 suggests that the syntactic semantic, pragmatic or any other such information theoretic account of the communication process either singularly or in combination, however insightful, or even useful they may be, are decontextualizing. In consequence, they are prone to providing us with a distorted understanding of the process of communication as we encounter and participate in it in our lived life. We wish to undertake in this chapter an examination of the sources of decontextualization in those formal approaches. We consider whether the very requirement of providing a formally closed coherent account of the phenomenon of communication at the levels of analysis aimed at, simultaneously confers on the formal approaches their capacity for distortion. As much of what we wish to argue relates to the creation and sharability of knowledge systems, at any rate of formal systems of knowledge, our observations, unless otherwise stated are not specifically restricted to information theoretic schema of communication processes.

For a start, consider Fig. 3.1 depicting a pattern that may be perceived as many things. For instances, it

may be perceived as an instance of the written word 'MU'. Or it may be construed as composed of the instances of the written words 'Reductionsim' and 'Holism'. It may also be considered as constituted of instances of the letters e, d, a, h, i, l, m, n, o, r, s, t, and u. These three descriptions, many would say, correspond to common perceptions shared by a large number of people. And even a realist whose ontology commits him to 'out-there' existence of things unperceived, will readily accede to the possibility of more descriptions that may be extracte depending on the punctuation performed, vantage-points taken. Given such a multitude of descriptions and perceptions, what is it that can be said to constitute and characterize our understanding of the pattern in Fig. 3.1? And what method or approach will facilitate our understanding? Over the ages to these questions there are three responses which we may, for convenience classify as reductionist, holist and Zen Buddhist. Reductionism asserts that to understand a whole is to understand its parts and reducing or decomposing the whole into its parts is the method. Or in more familiar terms, it maintains that a whole is nothing but the sum of its parts. On the other hand, holism claims that the whole is more than the sum of its parts. For all its emphasis on 'wholes', holism, apart from its lack of a positive programme for creating 'holistic knowledge' as

as constrasted with the 'dynamic' nature of the reductionist programme Or precisely because of its emphasis on 'wholes' - is unwittingly committed to conferring an autonomous status to the 'parts' in so far as it refers to 'parts' and their sum. Zen Buddhism refuses this committment by responding to the above question with a MU - an ancient Zen answer which may be said to unask the question. It rejects the premise of the question by focussing on the context in which holistic or reductionist accounts of reality are sought.

With these considerations in mind, let us enquire into the notion of reality so as to provide a context in which one or the other explanation of reductionism and holism is sought. We shall bring to light certain meta-theoretic accounts of the theories arising out of these two ways of looking at reality.

It may be useful for purposes of emphasis to state certain meta-rules about the knowledge Systems which are of interest to the present thesis.

1. All knowledge is a construct over reality. Universals in it are fallible. They are symbolic in nature. The 'distinctions' and 'oppositions' are created out of differances for the purpose of producing information. Hence no

claims are made as to their ontological status. All cases of exceptions transcend the universals.

2. A closer look at and a careful investigation into the analysis show that the more important aspect is not the 'entities' but their 'relations', not something 'out-there' not the 'being' (e.g. concept of information) but its 'relations' with the rest of the system. That is to say that the important aspect is not the concept of information, but the question as to how it has come into being; i.e., its process of becoming. The being is taken to be one particular stage of becoming. It is a punctuation of the becoming at a particular time and space.

3.1 Meta-Theoretic Account of Knowledge Systems

> 'Existence is infinite, not to be defined;
> And, though it seem but a bit of wood in your hand,
> to carve as you please,
> It is not to be lightly played with and laid down.
>
> ---
>
> But men of culture came, with their grades and their distinctions;
> And as soon as such difference had been devised
> No one knew where to end them.
>
> (Lao Tzu pp. 45-46)

Let us look at another picture - Verbrum - by Escher. We may find that at one level, reality is an undifferentiated

continuum. That is to say that a continuum exists in all that there is. But, at another level reality is 'multilevel' and 'multidimensional'.[1] This amounts to saying that there are different levels of reality and in any given level, there are many dimensions. Further, it may be emphasized that there is a continuous variation in any given dimension.

The significance of levels and dimensions are best elucidated with the help of a passage from Pascal.

> ' Theology is a Science, but at the same time, how many sciences there are! A man is <u>suppositus</u>; but if one anatomizes him, will he be head, the heart, the stomach, the vein, each vein, each section of a vein, the blood or, each humour of the blood?. A town or a countryside, seen from a distance, are a town or a countryside. But, as one draws closer, they are houses, trees, tiles, leaves, grasses, plants, weeds, ants, legs of ants, ad infinitum. All this is enveloped in the name countryside! [2]
>
> Pascal Pensees, p 29

---

1. levels and 'dimensions' of reality are themselves a results of digitalization which involves a perspective, a particular punctuation.

Levels and dimensions are, infact, created for methodological purposes. That is to say, they are integrally related to each other and thus cannot be treated in isolation. Care should also be taken that what looks as paradoxical at one stage may be resolved at a higher level. The 'opposition' of thesis and Antithesis at one stage is a result of a particular punctuation and it resolves itself at the level of synthesis which is indeed of a higher level. As Karl Marx puts it,

"It is only in a social context that subjectivnism and objectivnism, spiritualism and materialism, activity and passivity cease to be antinomies, and thus cease to exist as such antinomies. The resolution of the <u>theoretical contradictions</u> is possible only through practical means, only through the practical energy of man[1]". (Wilden p. 109)

By practical energy, we mean referring back to reality by which the particular punctuation that created the theoritical contradiction is superseded.

This multi-dimensional and multi-level reality seems to be 'analog'. In reality there appears to be only 'differences' and no 'distinctions'. Looked at in this way there is an extremely large amount of information.

Man, however, has the capacity to deal with a large amount of information only at the level of sensation and feeling. A picture for example, which is said to be worth thousand words, is very well appreciated by the human mind. Human mind is able to visualize a picture at the level of 'differences' and 'similarities' between its parts.

Man in his lived life, has to deal with situations not only at the level of sensation and feeling but also at the level of articulation and communication of the situation at hand. The knowledge acquired at the level of sensation and feeling do not seem to be easily expressible. As for example, how does one communicate the colour of a horse or a cow that one sees?

There is no way for one to express the exact colour of the horse or the cow. That is, the information grasped at the level of feeling and understanding, do not seem to be expressible. Human mind seems to have a limited capacity at the level of cognition and articulation (which is an essential requirement for transmission and reception of knowledge). Man's capacity to deal with extremely large number of categories, [1] (if they exist at that level) such as different colours, is highly limited.

---

1. Milles George A. 'The Psychology of Human Communication'.

The results of certain psychological experiments reveal that the number of 'categories' that can be dealt with by (human) cognition in many fields of human communication lies in a range of seven plus minus two*1 (This is explicit in a large number of human activities such as the perception of colours, sounds, numbers, etc.). When man makes use of a smaller number of categories, there is loss of information and his dealing with situation is very coarse. Take for example, if one has only the concept of two colours black and white, then his capacity to communicate the range of colour is highly limited. On the other hand, if he makes use of a large number of 'categories, he is unable to handle them and create enough significance out of the situation so as to take decision for his action. His effectiveness, therefore to deal with situations decreases.[3]

It may be pointed out here that human tendency to classify things and objects may be one of his ways to get out of this limitation. When the number of categories increases beyond a certain limit, these 'categories' are grouped into a few classes so as to make it possible to deal with them in terms of the classes which are fewer in number .

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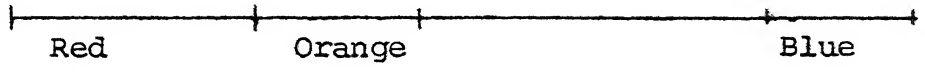
2. This terminology is used here only to facilitate the discussion. categories are not yet created. It is only at the level of cognition that they appear.

3. Schroder studies the relationship between the enviornment complexity and the level of human processing structure. The general behaviour seems to have the following pattern

(Schroder pp 36-41)

The above consideration points towards the incapacity of human mind to deal with a large amount of information arising out of the real life situations. Looked at in this way, it may be stated that the human mind reduces the amount of information by impoverishing the number of categories. This is made possible by the process of 'digitalization' of the analog reality. This is achieved by making 'distinctions' out of seeming 'differences'. A closer look at the verbrum picture discloses how glaring 'distinctions' may be made out of seeming 'differences'.

The process of digitalization is characterized by drawing 'boundaries' [1] and thereby creating 'categories'. In the example of colours, a boundary is drawn between any two colours and the colours falling in between two successive 'boundaries' are categorized as one particular colour. If we talk in terms of wave length, light with a range of wave length is categorized as one colour. . . . . The nature of 'boundaries' is very deceptive (elusive) here.



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*1 'The introduction of closure into the real as an epistemelogical and methodological act corresponding to the necessity of constructs in explanation and of digitalization in communication'

(Wilden p. 204).

For example, we can never say whether the wavelength at the boundary has the colours of Red or Orange. We shall be discussing the nature of boundaries and the problems bearing on it later in the thesis.

On the basis of the above discussion it may be mentioned that all organized knowledge systems (of past and present) are particular digitalization of analog reality and therefore reductionist in nature. This is so because of the limitations of (human) perception and cognition [1]. Moreover, all digitalization involves boundaries and drawing boundaries call for a particular punctuation of reality. Every punctuation of reality involves value[2] and therefore no knowledge system is value-free.

This reduction and digitalization seem to be an unavoidable requirement for cognition and organized knowledge. Regarding communication and knowledge in general, man makes use of both analog and digital means for the purposes of know-

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*1. Perception and cognition should be distinguished from sensation and understanding. The latter ones are at the level of feeling while former ones, at the level of articulation.

2. 'There can be no distinction without motive and there can be no motive unless contents are seen to differ in 'value'.

(Wilden : p. 170)

ledge and communication.[1] As for example, we use analog means such as pictures, gestures and the like.

Human mind, moreover, has the remarkable capability of producing analog experience and knowledge out of the digitalized versions. It seems to have the capacity to fill the 'gap' created by the process of digitalization[2]. For example, we can continuously experience the emotions arising out of a music without thinking in terms of the digitalized notes that produce it. So is the experience in the case of language. This almost mystical capability of the human mind makes it possible for man to use the digital means in order to know and communicate his analog experiences. That is what we mean by the symbolic use of digital means.

This, however, is the positive aspect of it . The negative side arises from that fact the the process of creating an analog experience out of a digital means is possible only when we realize that the digital means is a particular punctuation of an analog reality and is created for certain methodo-

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1. All non-conventionalised 'gestures language', postures, facial-exprossion , inflection, sequence, rythm, cadence and indeed the context within which human communication takes place, is a type of analog communication. All denotative, linguistic communication is digital.

2. This inverse mapping, it may be noted, can never be exact; but only a range could be specified. The remblance (similarity, nearness) to the original experience is derived from the context that is provided.

logical purposes. In the absence of this realization, we seem to be losing (at least for quite sometime) this capacity and thereby taking digital means as having its own existence. In this stage digital means loses its symbolic character, and acquires an independent existence. An organized knowledge system and a digital communication process where we have the reduced reality in digitalized form, may therefore be used in the following two ways.

The digital representation may be used as a means to create analog impression (or for acquiring knowledge of analog reality). That is to say that it creates 'meaning' out of 'signification'. The other possibility is that an independent existence is assigned to it having taken its 'categories' as real. The first approach results in a 'Symbolic' system and Symbolic communication while the second results in an Imaginary system and an Imaginary communication. This imaginary system 'is not in the least an imaginary one. It is in the realm of images, doubles, mirrors and specular identifications' (Wilden : p. 20). The Symbolic system and Symbolic communication are characterized by the fact that it is not 'objects' and 'entities but their functions which are of crucial importance to the whole process.[2]

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2. Take, for example, two sentences - 'Pin-pricking pains' and 'one feels pain when pricked by a pin'. They seek to serve the same symbolic purpose even though their individual parts may be different.

As pointed out earlier, there is a possibility of acquiring knowledge and that of establishing communication of the analog reality through a digital means as long as we recognise[1] the symbolic role of the digital means, of categories which have got no real existence[2]. That is, they are created for a methodological purpose and are supported by a particular punctuation.

But, more often than not, we forget their symbolic nature and assign an independent existence to these 'objects' and 'entities'[3]. Thus these 'objects' and 'entities' get paramount importance and their function as symbols is declared subsidiary. In this way, the possibility of communication decreases. As Wilden has put it

> 'The most interesting character of the symbolic exchange is that the symbolic objects cannot be expropriated or possessed, since function of such exchange is not accumulation but maintenance - at all costs - of the relation between the exchangers and possession of the objects would break the circuit and the exchange would cease'.
>
> (Wilden : p. 20)

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1. Of all knowledge systems, Zen Buddhism seems the most concious of the symbolic nature of things and all efforts are made to transcend 'things' and to reach to their meaning - their functions in this system.

2. The things themselves, which only the limited brain of man and animal believe fixed and stationary, have no real existence at all. They are flashing and sparks of the drawn swords, the glory of victory in the conflict of opposite quality'.

   Nietzsche, 'Philosophy in the Tragic Age of Greek'.

These 'objects' and 'entities', when free from their symbolic nature, give rise to 'Imaginary' systems. These Imaginary systems are abstract systems having no reference to reality as such. They, in contrast to symbolic ones, are unbounded by the reality from which they are derived and hence move away from the reality. Once the symbolic character of these 'objects' is forgotten, the Imaginary system takes over and there is a loss of communication. The knowledge system based on this Imaginary world becomes untrue and oppressive. Erich Fromm brings out this aspect clearly in the following way

> 'Language is one of the most precious human achievements ... yet one must always be aware of the danger of the spoken words that it threatens to to substitute itself for living experience. The same holds true of all achievements of man; ideas, art, any kind of objects ... They are man's creations, they are variable aids, yet each one of them is also a trap; a temptation to confuse life with things, experience with artifacts'.
>
> (Fromm E. : p.46)

Modern civilization with its devotion to objectivity suffers most from this reduction of 'symbolic' nature into an 'Imaginary' one.

> 'In so far as the predominance of 'Imaginary' in our culture results in a reification of natural and ecosystemic relations between human beings, - the conversion of similarties and differences into pathological identities and appositions, - the Imaginary order does not fulfill its function as an instrument of the symbolic, it subverts and subjugates it'.
>
> (Wilden : p. 25)

Once this reduction takes place, the only way we can recover from it is by referring back to reality of which this 'Imaginary' system is a reduction and reasserting the symbolic nature of the world of 'objects'. We can, thus, transcend the individual 'identities' and 'oppositions' of the 'Imaginary', by an entry into the collective 'differences' of the 'symbolic'[1]

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1. We may note here that this reduction has taken place in the past and the contemprary great thinkers have tried to bring back the symbolic nature of the system into the focus. The concept of 'alienation' in Marx, of 'negation' in Sartre, of 'Maya' in Sankara's Vedanta, of 'Mara' in Budhism, are manifestations of the different aspects of the 'Imaginary' at various levels of existence. They are similar but not identical. We shall take a few representative examples from these thinkers.

> 'Alienation is apparent not only in the fact that my means of life belongs to some one else, ... but that everything is something different from itself, that my activity is something else and finally ... that inhuman power rules over everything else'.
>
> Marx (Fromm p. 151)

> 'Rid of formalised wisdom and learning,
> people would be a hundred fold happier,
> ...
> Set people free.
> And deep in their hearts they would like to be
> from private greeds
> And wanton needs'
>
> Lao Tzu

So, any effort to know and to communicate is to 'digitalize' - to reduce _ reality. It is to view reality in one or few of its levels and in one or few of its dimensions at a given level. As stated earlier. An 'arbitrary' boundary is drawn between the systems (with certain levels and dimensions of reality)and the environment (the rest of the reality). This drawing of boundaries takes place at

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'Knowledge is enveloped in ignorance. It is that beings are constantly falling prey to delusion'

Gita 15/5

'The unenlightened soul is unable to look through and beyond Maya which like a veil hides from it its true nature ... it identifies itself with its adjuncts (upadhi) - the fictitious offspring of Maya, and thus looks for its true self in the body, the sense organs, and the internal organs (manas) i.e. the organ of specific cognition'.

Shankara

'The life means to live, to move, to act, not merely to reflect. Is not ... its development should be towards acting or rather living its truth instead of demonstrating or illustrating its truth in words, ...? In the actual living of their life, there is no logic, for life is superior to logic'.

Zen Buddhism

While discussing the different thinkers, we should not confuse the different levels of reality that they are talking about. It should be mentioned that they are talking about the process of reduction, of alienation that takes place at different levels of existence.

three levels - at the level of levels, at the level of dimensions and at the level of quantification along a particular dimension. Moreover, drawing of boundaries between the system and the environment should be differentiated from the drawing of boundaries between different parts of the system. Though, there is a continuity in these two, it is necessary to outline the distinction in order to avoid confusion between holistic - approach and system - approach, as they occur at different levels.

3.2 Knowledge Systems and Processes of Communication

Two important observations may be made on the basis of previous considerations; firstly, that knowledge may be acquired at two levels - one at the level of feeling and understanding and the other, at the level of cognition and articulation. The second observation related to the first one, is the possibility of articulation and communication at three levels Real, Symbolic and Imaginary, corresponding to the concepts of 'Real', Symbolic' and 'Imaginary' as discussed previously. A detailed discussion on these two observations follows in the next two subsections.

3.2a Knowledge Systems : Unorganised and Organised

It seems plausible from the foregoing discussion that knowledge may be acquired at two levels. They are : (1) at the

level of direct experience[1] so to say, knowledge acquired out of feeling and understanding and (2) at the level of cognition, that is knowledge, out of organization and articulation. Knowledge acquired at the level of feeling is unorganized and unarticulated. We may say that direct experience in its entirety can can never be articulated and organized. 'The intellect may argue and debate; it may learn and teach a vast amount about anything but it can never know'(Humphreys : p.4-5) Upanishadic concept of 'Neti-Neti', Syad-Vad theory of Jainism and the like are the manifestations of this realization of the incomprehensibility of reality in terms of organized knowledge. That is, this knowledge is not accessible in terms of the categories developed in organized knowledge and their linguistic equivalents. It may be acquired only at the level of intuition. Organized knowledge, on the other hand, deals with 'categories' developed by drawing 'boundaries' and 'punctuating' reality in certain ways.

Organized knowledge can be further classified into two : (a)'entity-based-knowledge' and (b)'relation-based-knowledge'.

---

1. These direct experiences ranges from the undifferentiated knowledge of reality - where the known and the known become one, to our daily experiences of say, a tree, unmediated by our thoughts.

The entity-based-knowledge system takes 'entities' and 'categories' developed through the process of 'digitalization' as fundamental to its ontology. It is a world of concrete entities isolated from each other and from the rest of world[1]. This isolation is created by interpreting boundaries between 'objects' either as non-existent or as barriers.

This interpretation of boundaries as non-existent or as barriers is made possible by, first, suppressing the multilevel realtions among the 'objects' of a system it deals with, and also between the systems and the environment, into an unilateral relation, and second, investing this unilateral relation either in the objects, system or environment. The relations, if considered at all, is given not a central, but,

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1. These 'objects' essentially, are the closed systems for 'which the context is effectively irrelevent or defined as such (e.g. the solar system, the cosmos as a whole), an open system is one which depends upom its enviornment for its continuing existence e.g. an organism or a population'.

(Wilden : p. xxxi)

a subsidiary importance only,

> 'It still confers on the parts the ontological primacy over their relations ... it tells us nothing ... about those wholes such as socioeconomic systems in their enviornment whose relations are responsible for creating the historically constrained characteristics of their parts'.
>
> (Wilden : p xxxix)

The relation-based knowledge system, on the other hand, is concerned with the processes. It assigns no fixed ontological significance to the 'entities' and to the 'categories' developed. The 'objects' in this case, are mere conceptual categories. They unlike the fixed objects in the first case are in the process of evolution i.e. in the process of becoming. To this system of knowledge, 'relations' are primary. 'Relation' according to this view lies not within but outside the objects. The relations are in fact, supposed to be determinant of the process of becoming of the objects, the entities[1]. 'It is our relations which makes us what we become' (Wilden : pxliii). Boundaries which makes the relations possible are no more considered as barriers, as in the previous

---

1. '... Code is relationship without reaprocity of the code, message is recovered as noise'.

   (Wilden : p. 219)

System of knowledge. It is, in fact, the only means of exchange and, therefore, of paramount importance.

> '... boundaries far from being barriers are the laws of relations for open systems in reality, and it is our relations to these boundaries, including our discovery of them as their discovery of us which surely makes us what we become'.
>
> (Wilden : p. xliii)

Take for example the cell membrane, which is considered as a barrier according to the first view. Cell membranes turn out to be more dynamic than the cells themselves[1] - something that would have been very much expected from the second view point.

This relation-based-knowledge may be called the communicational or ecosystemic one. This is a view point by which a system (isolated for methodological purposes) is seen as an open system in continuous interaction with its multilevel context - its enviornment.

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1. 'The cell membrane is not a wall or a skin or a sieve. It is an <u>active</u> and <u>responsive</u> part of a cell, it decides what is <u>inside</u> and what is <u>outside</u> and what the <u>outside</u> <u>does to inside</u>. Cell membranes have 'faces' that enables cells to recognise and influence one another. The membranes are also communication systems. Things outside cell don't necessarily act on the interior by passing through the membrane, they may simply change the membrane in the same way that causes the membrane, in turn, to make changes in cell interior.'

   (Wilden : p. xxxvii)

The process constructing fixed 'entities' in an entity-based knowledge system is accomplished in three stages[1]. They are

1. The system is isolated from the environment. That is to say that the 'systems are viewed as entities and objects in neutral space like atoms in the void or galaxies in the cosmos' (Wilden p. xxxix)

2. Many levels of relationships are reduced to a single one (hierarchy is reduced to symmetry).

3. Relations are vested either in the system or in the environment.

> '... characteristics stemming from the actual organisation of the system are projected into the supposed 'instincts' or innate ideas of an imaginary individual.'
>
> (Wilden : p. xli)

The undermining of relationships and reducing their different levels into one are caused by the confusion between 'matter-energy' and information. (The two are equated in the 'entity-

---

1. 'This fundamentalism is fundamentalism that depends first on the misconstruction of the closure and context, second on the correlative lack of understanding that context have levels and third on its incapacity to deal with the real question of logical typing in biological and social systems'.

(Wilden : p. xxx)

based-knowledge'). Information controls energy and presumes certain purposes. (goal-seeking)

> 'The primary function of information is the regulation, control, and triggering of energy (work) in the interest of a goal ... it maintains, reproduces or increases organisation (gradient).'
>
> (Wilden. p. 202)

Regarding information, the energy component is entirely subordinate to the particular form or structure of variation that the physical base or flow may manifest. It is only in the light of informational analysis (with the understanding of purpose involved) that the notions of levels and logical types may be understood.

This distinction (between matter-energy and information) though present, does not seem to be dominant at the level of gross matter (such as stones, billiard balls etc). But when we move further to a higher level of organization, this distinction becomes more important. Any analysis that is developed without considering this distinction proves to be defective or misleading.

Western thinkers, especially after the renaissance period (we may even trace back the origin to Greek[1]) have been

---

1. The result of these two different approaches may be seen in Greek and Indian Mathematics and linguistics. For Greeks, 'becoming' was illusory, in the realm of doxa (opiniom and sensation). 'Being alone was subjected to knowledge whose subjects were 'atomperal universals'. For Indians, however 'becoming' was fundamental to its ontology. It was on the substratum of 'becoming' that 'being' emerged. 'Becoming' was said to have six modifications - genesis, existence, alteration, growth, decay and destruction. For Yaksha, for example, existence is one of the modification of becoming whereas for Plato, becoming is negation of existence, corruption of existence. The ideal of Greek logic was eternal sentences, while for Indians verbs were the fundamental notion of becoming and it was in this sense of becoming that roots and meanings were founded. For Greeks, numbers (integers excluding zero) were basic while for the Indians, it was algebra. (the relation between numbers.). It was their preoccupation with the natural numbers that prevented them from conceiving of zero and non-natural number. Indians, on the other hand, were able to conceive of all kinds of numbers - Surds, fractions imaginary etc. They did not even call them imaginary and real. The only category that they employed was 'exact' and 'in-exact'

pursuing the entity-based knowledge and have applied it to many levels of existence indiscriminately. John Locke, a social contract philosopher, for example, applied the same method to analyze human society. The result was that he ended up with psychobiological individuals who are isolated among themselves and from the rest of the world and who entered into a contract (and thereby they formed a society) with motives derived from their individualities. As Wilden says :

> 'The 'system' thus constructed is, in sum a mere aggregate or heap of (supposed) self-sufficienes. It is an atomic collection of so may Imaginary replica of'(individual) human natures', as it were, an aggregate of a number of so called 'human-in-the-state-of-nature', ... who apparently ran into each other ...'
>
> (Wilden p. xliii)

Consequently the different levels of relationship between individuals and society (in the form of different communities and intermediary organizations) have been reduced to a single one and this single dimensional relation is vested with the hypothetical individual. Thus it denied all communities and intermediate organizations owing allegiance to a monolithic state.

It is with the introduction of system theory, cybernetics etc., that the relation based knowledge system has come into force. As a result an ecosystemic and communicational

perspective is emerging.

3.2b Process of Communication Real Symbolic and Imaginary

In correspondence with the concepts of Real, Symbolic and Imaginary, communication may be attained at three different levels. The first level is of direct experience. This occurs at the level of experiences not mediated by our thought patterns. The second takes place at the level of articulated experience. At this level, though reality is grasped by means of categories, the mataphorical nature of the categories is preserved. It is context dependent and points to the possibility of having communication about the reality. Communication at this level is called symbolic. The third is at the level of signs and symbols having fixed signification devoid of meaning and context.

It may be difficult to establish communication about direct experience. That may be the reason that made most of the mystics to maintain silence (regarding the reality); the language of objectivity cannot legitimately make reference to many of our experiences and feelings. The only way, then, to communicate these experiences through language is by transcending the 'words'.

i.e. by creating apparent paradoxes[1] such as, 'It moves while resting'. This method of generating paradoxes not only points towards certain aspects of reality but it also goes beyond it, by arousing the faculty of direct experience. Incapability to comprehend and express this directly experienced reality in terms of 'symbols' and categories points toward the impossibility of its communication through any formal means. At this level of communication (of direct experience) the knower and the known become one and the same. That is, in this experience, there cannot be a reference to a perceptual object. Although every particular datum involves references to perceptions. In this process, the subject becomes a participant (For details see Cherry pp. 9-90) in his preceptions or rather a part of the process. The subject distorts the reality as and when he makes himself an external observer. The very effort to communicate, it seems, then, is to cause its failure.

The second level of communication which is at the level of articulated experience is symbolic in nature. Most of our day-to-day communication takes place at this level. They

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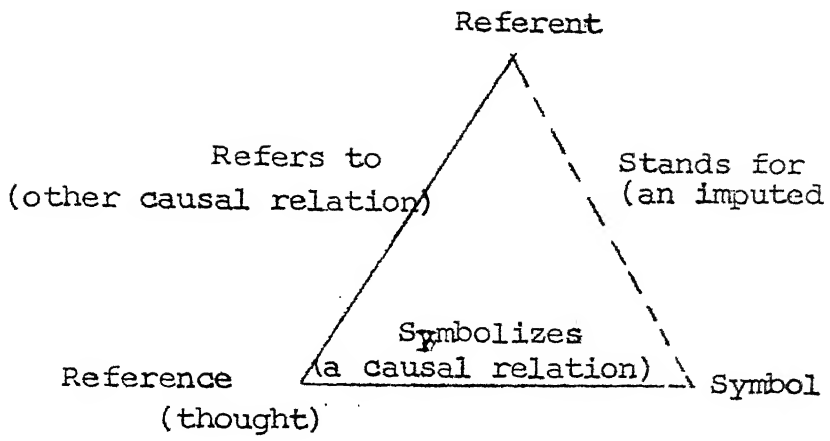
1 'Intuitionalism requires pointers more than ideas to express itself, and these pointers are enigmatic and non-rational. They are shy of intellectual interpretation. They have a decided aversion towards cirumlocations. They do not repeat, and brevity is their essense. They are like flashes of lightening. While your eyes blink, they are gone'.

(Suzuki : p. 25)

refer to certain 'concepts' and 'categories' developed through the process of digitalization but are related to the reality they refer to (extensionality). This relation between symbols and their objects in the external world is obtained through a thought process-a process of assigning meaning to 'categories (intensionality) which, in fact, involves meta-communication of 'categories' and, thereby, crossing of the boundaries between the two levels - levels of 'categories' and of reality. Ogden's famous triangle[1] demonstrates the triadic nature of communication through 'categories' - signs. Cherry draws a functional flow diagram in the following way[2].

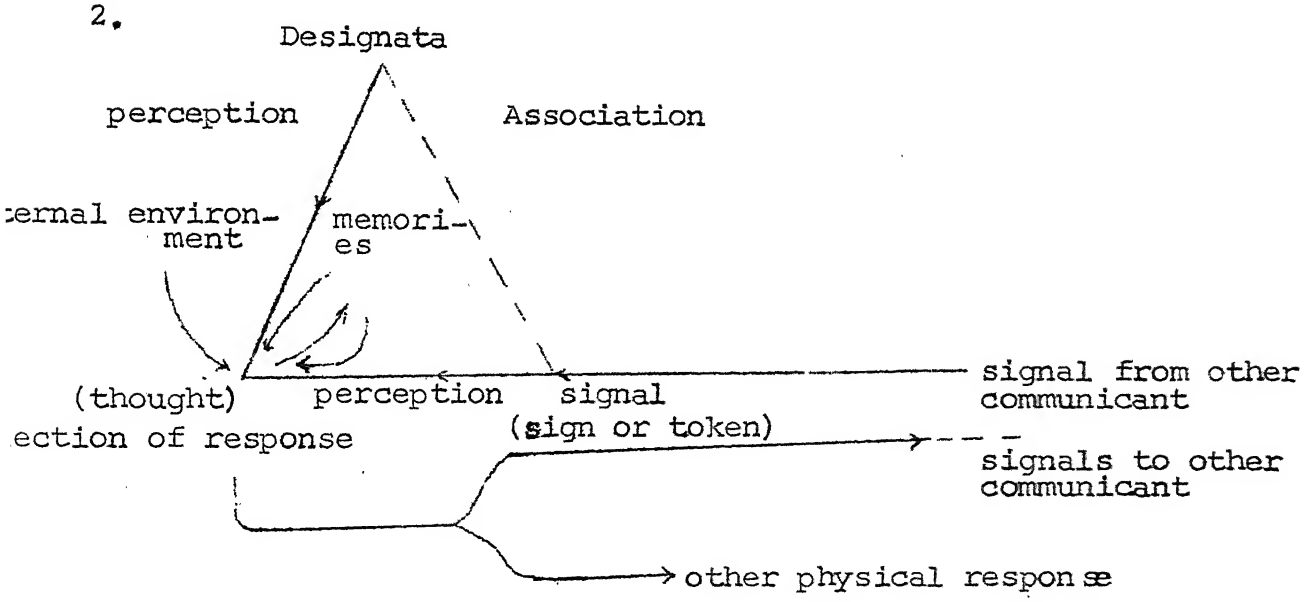
The dotted line shows that there is no direct relation between the symbols and the referents (the reality). Rather the relation is established through concepts and thought processes. It may be emphasized here that the whole thought process is involved while establishing a relationship between symbols and referents.

1.



The thought-word-thing triangle of C.K. Ogden (Cherry, p.110)

2.



'Meansings of words' A functional flow diagram (Cherry, p.110).

At this level of communication, signs and symbols acquire both signification and meaning[1]. Since they refer to certain aspects of reality, their effectiveness in terms of 'meaning'[2] can be proved only to the extent that they evoke experience of that reality. The world of these symbolic signs, then becomes an open system in the sense that words acquire meaning only in their context. As Hofstadter writes, it is isomorphism that induces meaning.

> 'The other kind of interpretation will be called meaningful. Under such an interpretation, theorems and truths corresponds - that is, an isomorphism exists between theorems and some portion of the reality ... that is why it is good to distinguish between interpretation and meaning'.
>
> (Hofstadter. p. 51)

It is the isomorphism of the overall structure (say a sentence) to certain aspects of reality, that suggests meaning. It may not be proper to attribute meaning to (individual) parts (signs and symbols). Even if we attach significance to

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1. The essential difference as we understand between signification and meaning, as mentioned in chapter II, is that former requires only a context (a closed one) where as the latter calls for a real ecosystemic context (with its many levels).

2. The concept of 'Meaning' is discussed in detail in chapter IV.

individual symbols, its meaning has to remain open. That is to say that it has to be context dependent. If one defines information in the sense of creating meaning, then information, eventually, becomes context dependent.

The process of communication at this level, therefore, calls for two requirements, over and above the physical transmission and reception of symbols, to be fulfilled on the part of the communicants. First, they need to have common experiences and, second, they use identical or atleast similar (symbols) to represent their common experience. Any mismatch at these two levels may result in the loss of communication. It may be extremely difficult to meet these requirements in real life. Thoughts (and so symbols) are grossly effected by language, social and cultural conditions, training and the like. This is further complicated by the fact that our experiences themselves are mediated by our thoughts i.e., by our conceptual 'categories'. It is probably for this reason that it is very difficult for communicants from two different cultures to communicate effectively. Despite these differences in thoughts and experiences, however, there is a possibility of communication. This is made possible by a significant matching at the level of deep structure.

> '... We have an intuitive sense that, although other people differ from us in important ways

> they are still 'the same', as we are in some deep and important ways'.
>
> (Hofstadter : p. 375)

Hofstadter draws an illustrative analogy between the drawing of a map of territory and the symbolizing of reality. (Hofstadter p. 369-376). In case of a loss of this minimum deep structure (core) in any field of experience, it will be impossible to communicate in that particular field.

A symbol when considered in its real multilevel contexts, is liable to have as many different meanings as there are levels in its context. Its specific meaning will depend upon the level of the context considered. A close look at the dialogue 'Contracrostipunctus'[1] (Appendix III) will reveal the existence of different meanings arising at different levels of the context considered. Take for example the sentence 'I can't be played on the record player X', It has different meanings at the level of immediate conversation. They are (1) at the level of two parts of the dialogue (2) at the level of the dialogue as a whole, (3) at the level of the chapter and (4) at the level of the book.

Communication at the third level occurs when the symbolic character of the symbols is forgotten. Symbols and

signs have been attributed an ontological status having a fixed signification. At this level, the system concerns itself only with transmission and reception of symbols and not with the 'meaning' of these symbols. Communication process at this level is a de-contextualized closed-system. It is in the world of Imaginary. In fact, the criticism made against Imaginary systems, as opposed to Symbolic ones more or less, applies to Information theory. It also turns out that most of the subsequent efforts limit themselves to this formal structure and that therefore, fall into the same category of 'Imaginery'.

Our criticism in light of the foregoing analysis, may be summed up in the following manner.

1. Any formal system is characterised by the process of 'digitalization' which introduces certain 'gaps' into the reality. These 'gaps' could never be filled up by the formal system itself, however complex, it may be. This statement may be compared to Godel's Incompleteness Theorem.

2. Even in the 'digitalized' system, there are infinitely many levels and dimensions of the real ecosystemic context. (we shall explain this aspect in Chapter IV) while discussing the concept of meaning.) A formal system, therefore,

will have to consider large number of levels and dimensions in order to encompass the digitalized system in its real context.

3. It is the symbolic character of the digital means - the symbols, that is important. That is to say, that it is the relationship (intentionality) between the 'symbols' on the one hand and the portion of reality on the other, and not 'symbols' themselves which make communication of reality possible. These relationships moreover do not seem to be amenable to complete specification.

4. The above consideration of intentionality suggests that for a successful communication of any portion of reality, there need to be a match between the intentionalities (the relationships) at the transmitter and the receiver ends.

CHAPTER 4

MEANING AND MODEL

Our discussion in Chapter 3, on the nature of reality and its perception by the human mind, suggests that the perceived or punctuated reality may have many levels and dimensions. It was also pointed out that it is the relations between the entities, the process of their evolutions and not the entities themselves, which are of central importance. In this chapter, we attempt to analyse the concept of meaning arising in formal systems and human communication process in the light of the notions mentioned above. In this connection we also explicate the concept of symbols and their relations. We consider whether a meaningful definition of meaning is possible or not. Our analysis is more in the nature of a consideration of the circumstances in which meaning can arise. It is suggested that meaning arises in a real context which itself is inexplicable in terms of categories. This context is made accessible through a process of punctuation mediated by motives or purposes that are themselves products of other punctuations. In order to explore the possibility of constructing a model, we have stipulated some of the requirements to be met by any such model. We have argued that any attempt to construct a model of real life communicational situations is rendered difficult by the non-availability of Knowledge, relating to the context specific levels and

dimensions, not only to the modeller but often even to the participants engaged in the process of establishing communication.

4.1 Meaning in Formal Systems[1]

In order to get into the complexities of 'meaning' as commonly used, we shall begin our analysis with an exploration of the question, 'How is meaning derived in formal systems such as mathematical and logical?' To that end, let us look at the following expression.

' - p -q - -'

One may suggest that it could mean a number of things. For example, it may mean 1 and 1 make 11 or 1 plus 1 equals 2 and the like. We shall now analyze this expression in the light of a formal p-q system whose axioms and rules of construct are given as follows.

Definition : xp - qx - is an axiom where
x is composed of hyphens only .

Rule : Suppose x, y, and z all stand for particular strings containing only hyphens. And suppose that x p y q z is known to be a theorem. Then xpq - qz- is a theorem.

---

1. A significant part of this analysis is derived from Hofstadter's, 'Goldel, Escher, Bach: an Eternal Golden Braid'.

This formal system produces the strings such as -p-q - -, -p - - q - - -, - - p -q - - -, etc. Thus our string '-p -q --' is placed in the framework of this system. A closer look at the strings suggests that some pattern or meaning slowly emerges out of these strings. At one point one may feel such that one has got the meaning of the expression and one may decalre that'-p -q--' means that 1 plus 1 equals 2.

A new question arises as to what makes us feel that we have got the meaning of the expression. It may be plausible to suggest that it is the recognition of an 'Isomorphism' between the pq system and the process of addition that we already know, which makes us feel so. It is suggested that 'meaning' emerges or a meaningful interpretation is obtained when an isomorphism is established between 'theorems and some portion of reality'[1] (Hofstadter : p.51).[1] Isomorphism is normally defined as an information preserving transformation. Looked at from another level, the word 'Isomorphism' applies when two complex structures can be mapped on-to each other in such a way that each part of one structure, has a corresponding

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1. The term 'reality' is used by Hofstedter for both the physical and mental world, we, for this part of the analysis would accept the same.

part in the other structure, where 'corresponding' means that the two parts play similar roles in their respective structures'. (Hofstadter : p. 49).

It may be noted here that it is the similarity in roles and not in the parts themselves that is fundamental to isomorphism. A 'role' implies relation between different parts and therefore it is their relation and not the parts themselves that suggests an isomorphism which, in turn, induces meaning. Relation, therefore, may be suggested as fundamental to meaning. It may be understood that, given an isomorphism or a possibility of 'isomorphism', meaning is derived through interpretation where symbols and their relations of formal systems are correlated to the parts and relations of the portion of reality concerned.

It seems necessary at this stage to differentiate between 'meaning' or rather a 'meaningful interpretation' and interpretation. A symbol or a theorem can be given any interpretation, say for example, Þ can be interpreted as paste or pen or anything-else, but a meaningful interpretation occurs only when theorems (portion of the reality which we are concerned with) correspond to the [illegible]. That is to say, an isomorphism exists between interpreted theorems and some portion of reality in case of a meaningful interpretation.

Another point to be noted in this regard is the levels of interpretation. In pq system, for example, the interpretations were made both at the level of symbols and at the level of theorems. We may call this as the higher level of interpretation which corresponds between theorems and the portion of reality. This higher level correspondence, it should be noted, can not be percieved without the lower level interpretation[1]. To sum up the discussion so far, in order to describe hidden meaning in a formal system, its symbols should be assigned interpretations in a meaningful way by which a higher level correspondence emerges between the true statements and theorems.

Before we end our analysis on 'meaning in formal systems', let us state that a good imitation of a portion of reality by a formal system has been possible because the portion of reality considered (i.e. addition of number) is itself an abstraction.

4.2 Meaning in Human Communication

We have explained the concept of meaning in a formal system in the previous section. Let us now concentrate on the

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1. It is important to note that there seems to be contradictory requirements. A meaningful interpretation of the parts is obtained when one finds an isomorphism between two structures, but on the other hand a correspondence can be achieved only when parts are interpreted.

concept of meaning in human language (or rather in human communication processes.).

The first important point to be noted in this regard is the difference between 'passive' and 'active' meanings. In a human language, meaning of a 'word' that is learnt in one specific context may be used to make new sentences in the same context and to a large extent in different contexts. That is to say that 'it brings into being new rules for creating sentences', Meaning in this case is said to be 'active'. For example, in natural language once the meaning of Þ as plus is understood in the context say Þq formal system, it can be used to formulate sentences like '-Þ-Þ-q ---' i.e.;1 plus 1 plus 1 equals 3, which according to a formal system is not even a well formed string (not to say its theoremhood). In a formal system, on the other hand, meaning is defined only within that system and is applicable only to theorems which are pre-defined. Any attempt to apply it to a different set of strings such as '-p-p-q ---' as shown in the previous example is invalid. Meaning of the symbols in this case is said to be 'passive'.

Another important aspect to be discussed in this regard is the difference between 'implicit' and 'explicit'

meaning. It was shown in the previous section that meaning emerges when there is an isomorphism between rule-governed symbols and things in the real world. Depending upon the complexity of the isomorphism, more or less effort is required to extract the meaning from the symbols. In case of a very simple (or very familiar) isomorphism, we are tempted to say that the meaning that it allows us to extract is 'explicit'. In natural languages, for example, 'people attribute meaning to words in themselves, without being in the slightest aware of' though very familiar with', the very complex isomorphism that imbues them with the meaning'. (Hofstadter. p. 82) They attribute all meaning to the symbols undermining the role of links between the symbols and the real world. On the other hand, if the 'isomorphism' involved is complex and unfamiliar, one has to labour hard before he is able to extract meaning out of it. That is to say that the decoding mechanism involved is highly complex. Meaning in this case is said to be 'implicit'[1].

The third important point to be discussed is the notion of 'isomorphism' . Isomorphism, in the case of natural languages, in contrast to formal systems, needs to be a fairly

flexible concept as it has to account for the complex symbolic processes involved in natural languages. In the case of natural languages, looking for an isomorphism is very similar to asking 'when are two things similar'. A look at the G-plot (Fig. 4.1.2.(2)), for example, will suggest that every part of the graph is similar to the graph itself. All that could be said in relation to these graphs is that it is the mapping of their functional relationship between parts that makes this similarity possible. At a still deeper level, e.g.: at the level of finding similarity between different pictures by Escher, one may find that even the specification of functional part is difficult. It is their sameness in the 'style' - an equally ambiguous term that makes them similar.

Another question, though seemingly opposite but related to that of similarity is 'when is one thing not always the same? It is like asking when a particular thing is different under different circumstances. This is directly related to the question of whether meaning is inherent in the symbols (messages) or whether meaning is always created by a mind or a mechanism with a message. Meaning in the first case may be said to be 'universal' or 'objective' and located in the symbols. However, nothing about the location or the 'universality' of the meaning could be said in the second case as

each observer could bring his own meaning to each message. In natural languages, symbols seem to have both objective and contextual meaning. By contextual meaning is meant meaning dependent upon the interpreting mechanism and by objective meaning is meant meaning independent of the context. Symbols on the one hand have got some objective meaning, for instance, the dictionary meaning, while on the other hand they change their meaning depending upon the context they are placed in. Take for example the sentences 'The politicians lie' and 'cast iron sinks' and 'The politicians lie in cast iron sinks'. Notice how the meaning of the words 'lie' and 'sink' change with context.

The fourth important point to be noted is the emergence of higher levels in natural languages and the simultaneous treatment of symbols at different levels by the human mind. In case of formal systems a higher level system can be built up over a given system by using its theorems and rules as the basis to define axioms and rules for the new systems. Higher level languages for example, are based on this process. While building a higher level system, it may be noted that a fault at a lower level cannot be corrected at the higher level. Escher's 'Relativity (Fig. 4.1.2) shows that once you

perceive the person's climbing up or down the stair case, you cannot correct yourself at a later stage when you realize that the higher level perception is resulting in contradictions. Human languages seem to involve extremely large number of such levels. A particular set of symbols with their relationships, when they occur frequently, is condensed into a symbol - a symbol that represents a set of symbols and their interrelationships. Consider a symbol like 'democracy'. However, the main difference between a formal system and human language is that in the latter case, unlike in the former, different levels can be dealt with simultaneously. Human mind seems to be quite capable of dealing with these levels simultaneously. (It is tentatively proposed that this capability to deal simultaneously with different levels may turn out to be one of the essential characteristics of human intelligence.) A condensed symbol is frequently used with ordinary ones. As for example we say 'People in democracy need to be responsible'. Symbols like 'People' 'democracy' 'responsible' belong to different levels but are dealt with in a normal manner as if they belong to the same level.

In this context, it may be helpful to discuss the relation between different levels in a system and the effect

of the structural and systematic perspective adopted by the human mind.

The multi-levels of language may be looked at from two different perspectives. As for example, let us take the case of computer programming language and see how a higher level language gets developed.

Structurally the machine language is constrained by its hardware and assembly language is constrained by the machine language and so on till we reach the highest level of language. So in computer language, when seen in terms of its structure, the lower levels seem to constrain, or to a large extent, determine the higher levels. The complete determinacy is avoided by the fact that the relations between lower level structures do not belong to and therefore are not determined by the lower level structures.

However, if we analyze from the perspective of 'purpose' and 'goal-seeking', then the situation seems to be different (or probably opposite). Supposing that we want to execute a certain task which requires certain functions to be carried out. These functions can be executed through certain procedures and subroutines such as mutliplication inversion etc. These pro-

cedures and subroutines, in turn, can be broken into certain basic procedures such as additions and subtractions. It may further be reduced in terms of certain logical functions such as 'and', 'or', moving left or right etc. No further reduction seems to be conceivable. These basic logical functions then, have got to be hardwired. If such reduction to these simple functions is not possible (or is inefficient) then we may have to make the hardware differently (or say hardwire at a higher level). Supposing that such situation is being considered, that it does not come under ordinary logic of, 'and' , 'or' etc. We may have to try imitating the basic logic that our situation follows in its execution and the like. Looked at from this perspective of the 'purpose', it seems plausible that the higher level determines the lower level.

The situation becomes more clear in the case of natural language . The syntactic structure, for example, determines to a large extent, the type of meaning that can be dealt with. This, however, does not limit 'meaning' completely. A sentence may be syntactically wrong but it can still convey meaning. The situation may be seen as a case of forming a new syntactic rule for a particular purpose. In fact, we continuously seem to introduce new rules of syntax in order to invest

new meaning into words for newly arising situations. Symbols of natural languages , in this case are said to be 'active'.

The two perspectives seem to be leading to contradictory positions. But that is not quite so. A close analysis may reveal that they are, in fact, complementary. If we take the synchronic view point i.e., a static situation, then we find that the first perspective becomes meaningful. But when we take the diachronic view - a dynamic situation, the evolutionary real life situation, we find that it is the second perspective that is meaningful.

A safe and alternative position could be like this. We create a structure and its substructure for a purpose. Once we make this, we need to stick to it for the purpose of meaningful exahange (communication) ;we, however, can transcend the structure - modify it or change it, in case we find that either our purpose is not being served or the purpose itself has undergone a change.

Another point to be made regarding the difference between formal system and human communication process is the difference between the information bearer and the triggers; the corresponding decoding mechanism being information

revealer and Jukebox .. . A trigger of information implies the mechanisms to pull out the information from it is far more complex than the trigger itself, and the context seems to be a must for it. DNA in organism, for example, undergoes an extremely complex process before its phenotype characters are revealed. In the case of information revealer conversely, the decoding mechanism is simple and the information can be decoded by any sufficiently powerful intelligence even if placed out of context. That is to say, it has the capacity to restore its environment. (A record for example can be thought of as bearer of the sound it produces.) It may be instructive to note that the isomorphism in the former case is said to be 'exotic' . In such cases, it is highly non-trival to divide the structures (e.g. geno-type and type) into parts which can be mapped into each other. While in the latter case, it is said to be prosaic (where part of one structure is easily mapped onto the parts of the other as in the case of record and sound produced by the record.

The final point to be noted in connection with formal and natural languages is the difference between the outer message and the inner message. The outer message instructs the rule of decoding i.e., it tells us how to build or to know how to build the correct decoding mechanism for the inner message.

Inner message, on the other hand, is the meaning extracted from the message. These two levels, however, are related intrinsically. To get the outer message, for example, one requires to know all the semantic rules with its intricacies. But once this is known the inner message is already available. It is important to note here that outer message cannot be a part of the inner message. It has to be known from outside or should be deciphered before inner message is read. Inner meanings can at most act as triggers.

Realization of this difference between the inner and the outer messages suggest that it would be impossible to communicate the inner meanings unless their outer message is available at some level. That is to say that there is a commonly shared decoding mechanism (a jukebox-human mind or brain in this case) We say, 'at some level', because when seen closely, it is found that an outer message itself is an inner message of another outer message. (every set of rules has a metarule that decides the rule of using the rules). And this will lead to infinite regression unless there is an agreement of the outer message at some level, and this in case of human languages seems to have been achieved at the the level of the basic brain structure. Human mind is

constrained to think in a certain manner[1]. When brain is able to interpret the incoming data as a message, we need no more rule. Moreover, we need different brains to respond in some similar manner; 'if different people had different brain structure and had responded to given triggers in completely idiosyncratic ways, we would have had no inclination to attribute intrinsic meaning to the triggers. It is the minimal in born ability to extract inner meaning' that 'allows a highly recursive, snowballing process of language

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1. One may get the feeling that as intelligence is embodied in the brain which is hardwired, there is a possibility of it being described formaly . This, however is not true for the following two reasons. Firstly, it may not at all be possible to describe the hardware of the brain completely and secondly, the intelligence calls for the emergence of higher levels of structures from the lowest level brain structure. There is a possibility of certain aspects of higher levels which cannot be represented at a lower level at all 'there could be some high level way of viewing the mind involving concepts which do not appear on lower levels, and that this level might have explanatory power that does not exist not even in principle - on lower level' (Hofstadter: p. 708). 'These qualities could be called emergent in the sense of requiring explanation which cannot be furnished by physiology alone (Hosftadter: p. 709). Imitative theorems such as Godels incompleteness Theorems, for example, points towards this fact - that higher levels are not completely determined by the lower levels.

acquisition to take place' (Hofstadter : p. 171). 'Human brain is so construed that one brain responds in much the same way to a given trigger as does another brain, all other things being equal'. (Hofstadter : p. 172). It is this uniformity of human jukeboxes that establishes an uniform language in which the outer message can be communicated and it is their inborn languages that makes the learning of higher level languages possible.

4.3 Symbols in Human Communication Process

Having taken note of some of the important differences between concepts arising in formal and natural systems, we now wish to analyse the concept of symbols in human communication process.

In Chapter 3 an attempt was made to represent the nature of reality, especially as it is perceived by the human mind. It was pointed out that with perceived reality may be associated a large number of levels and dimensions. It is plausible therefore, to suggest that the human language, which seeks to express that perceived reality, has to have many levels over and above the dimensions. In what follows we have tried to exemplify this aspect.

We shall first examine 1) the concepts of symbols and their relation and 2) formation of higher levels of symbols and in turn relations between them.

It will be desirable at this point to have an idea about the concept represented by it. It should be observed that most thoughts expressed in a sentence are made of quasi atomic concepts which we do not analyse further. Looked at it this way, it may be reasonable to suggest that symbol is a unit of thought to which you know a word, stock phrase or a proper name.

The process of evolution of symbols and the inter-relationships between them may be better understood with the help of the following three observations made on the basis that symbols are units of thought.[1]

Firstly the symbols may be active or dormant. Symbols are normally lying dormant but they can be activated by triggering-externally and internally. Symbols can be activated in many ways; a symbol when activated can act in many ways upon other symbols. Thirdly, symbols trigger other symbols by sending messages in such a way that triggering patterns are very much like the large scale events in our world or in a world very similar to ours.

Before we discuss the formation of higher levels of symbols it is desirable to have an understanding of the lowest level of symbols. However, it seems difficult to point down the lowest level of symbols. In fact it turns out that the symbols are connected through strange loops; i.e., they are not heirarchical but heterarchical in nature. A higher level symbols in course of time, defines a lower level symbol. For instance

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1. Hofstadter makes these observations based on his analysis of symbols at the level of signals and neurons.

(Hofstadter, pp 337-348)

an electron model is explained in terms of solar system model, while, earth, a part of the solar system, is explained in terms of electrons.

Human body is explained in terms of organs, sub-organs, genes etc. But genes themselves may be thought of as to contain the whole human body within it. Mutation of genes is explained in terms of mutation in the whole body.

Though, it seems impossible to point out the lowest level of symbols, nevertheless, there are certain symbols and relations which seems to be commonly shared by all human minds. Thiscommon sharing may be attributed to the hardware like characteristics of the brain. Brains of human being seems to be hardwired in more or less similar manner; moreover they are all exposed to certain common natural external environment (rivers, hills, trees etc.) and human experiences (such as pain, hunger etc.). The symbols corresponding to these basic categories are shared by the members of the species. It is probably the sharing of these symbols and the triggering paths by the human brain that makes possible communication between people of different cultures and time.

These symbols, though form the core of the symbols in the human brain, are by no means of the lowest level. We shall discuss further about these commonly shared symbols while

discussing isomorphism between human minds. It may, however, be pointed out that though these symbols form the important part of the symbols in human mind, they are mostly referred to only when there is a mismatch between the symbols developed over these symbols.[1]

With this background about the symbols and their relation we proceed to examine the process of formation of higher level of symbols.

4.3.1 Evolution of Higher level Symbols

Accepting that the reality is perceived in terms of categories in most of the cases, when the categories increase beyond a certain fixed or finite number (say seven plus minus two), categories are grouped into higher level categories by recognising certain common relationships among the members of a group. For instance, at one level we talk of animals such as tiger, elephant, deer, dog etc., while, at another level we talk of a class of animals, a class of living being etc.

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1 Take for example the instance where one does not have the symbol for the structure of the atom. We explain it by saying that an electron rotates round a nucleus, as earth rotates round the Sun. Similarly to explain the concept of symbol corresponding to 'force', we refer to our commonly shared experience of force.

The reverse process of splitting up of a higher level category into a number of lower level categories is done for the purpose of creating greater signification or more information. We, for example, describe human body in terms of organs, organs in terms of suborgans etc., till we reach concepts like genes and DNA's in order to know more about human body. A similar process of forming classes out of instances and instances out of classes seems to take place in the field of symbols in human language also.

In many cases when the lower level symbols increases beyond a certain finite number, then those set of symbols along with their relations, which occur more often, are chunked into a single symbol of a higher level. For example, 'the set of symbols animals who live on vegetables' are chunked into one symbol 'herbivorous'.

Take another word 'propositionalizable' for example. It represents an idea or a thought that could be expressed in terms of stated assumptions. This concept seems to have developed in the following sequence.

pose → propose → proposition → propositional → propositionalize → propositionalizable.

Symbols like 'democracy' and 'religion' for example are the result of very high level of chunking and when expanded will call for a large number of lower level symbols for its explanation.

The process of chunking can be further exemplified by the computer languages. Machine or Assembly language can be used to define certain subroutines and procedures which can be used in turn to develop higher level languages such as Pascal Algol etc.

When signification generated by a class is insufficient to deal with some instances forming this class, the reverse phenomenon of chunking takes place; i.e., the instances split off from that particular class and makes a class of its own. Note must be taken of the fact that this new class has many of its characteristics derived from its parent class and is in that sense entangled with it.

This phenomenon of instances emerging as classes suggests that depending upon the context a symbol represents a class or an instance. For example, the symbol 'students' is an instance with respect to 'boys' while, it is a class with respect to say 'engineering students'.

The development of symbols which are complex and flexible in nature is better understood in terms of software like development. A hardware like account of this will become extremly difficult and probably even impossible. It should be pointed out at this stage that the distinction, between the hardware and software is not very sharp, symbols which work as software units, at one level may turn out to be hardwired like at a higher level.

The process of formation of symbols is neither stationary nor one way. The related symbols keep on modifying eachother. A recognition of new characteristics in an instance for example, may change the characteristics of the overall class. It can delete certain characteristics; it can split the class into two or many and so on. The newly formed class in turn may put new restrictions on the instances.

As an illustration consider the developments in the notion of electrons. The probabilistic account of the notion of electrons provided by quantum mechanics has changed most of the concepts in physics and related branches to the extent of changing our world view from deterministic to probabilistic.

Further, we wish to note here that symbols may be localized, i.e., they are located at one particular place in

the brain and made access to whenever necessary. For example, 'the nouns might have fairly localized symbols, while, verbs and prepositions might have symbols with many tentacles reaching all around the cortex or any number of possibilities'. (Hofstadter ; p. 361). The latter symbols are much more complex in nature and therefore difficult to analyse.

The foregoing discussion regarding the nature of symbols and their relations suggests that the symbols are integrally related to each other and therefore, cannot be activated in isolation. They are bound to activate, depending upon the context, some part or the other of the symbols from which they are derived and which are derived from them. This, however, does not imply that the symbols cannot be talked about in isolation. They are like individuals in society who though, integrally connected with eachother, nevertheless, maintain their individuality. As a matter of fact the identity or individuality of symbols lie precisely in its mode of being connected (via potential triggering links) to other symbols.

In what follows we wish to discuss the nature and characteristics of relations (triggering paths) between symbols. As mentioned earlier, triggering patterns of symbols are such that, they along with the symbols correspond to some events in

in the real world. It should be noted here that the reality we are talking about is not the same as the one discussed in Chapter 3; it is the perceived reality that constitutes the real world mentioned above. It also includes the imaginary world created by the human mind.

In a manner similar to active and passive symbols, triggering paths can be classified as 'possible' and 'potential'. Given a set of symbols there may be some triggering links which are travelled more often than the others. They are like highways. Such triggering paths are called possible links. The potential paths are like other roads which are trodden only when highways are out of order or when the highways don't cover the places to be visited.

It should be noted here that it seems possible to give only a conditional or probabilistic account of the triggering paths. One could atmost say, if such and such things happened, such and such paths may follow. Moreover, the context which decides for a particular triggering path, itself is not decidable - it is conditional or probabilistic. What we have, therefore, is only a probabilistic catalogue of possible pathways under possible circumstances.

The highly probable trigger paths (if not all at least some of them) in our mental world may be thought of as

the chunked laws of physics, biology, psychology, sociology etc. This is to say that we normally expect the symbols to trigger these probable pathways. This however does not mean that the other pathways are not permitted. We can conceive of the triggering paths which do not fall in line with the conventional chunked laws; for instance, we can meaningfully think of a gene containing the whole human body inside it.

While talking about the chunked laws of physics, biology etc., it is desirable to differentiate between declarative and procedural laws and their representation in the human mind. Procedural laws are usually spread all over in pieces and they are not encoded as facts but only as programmes. Like programme human mind does not know how it does it. Procedural law is a global consequence of how the system works (not a local detail). It is an epiphenomenon[1] and cannot be retrieved at its own level (it may however, be possible to retrieve it at a higher level; a programmer, for example, knows how a programme works. Declarative laws on the other hand, may be thought of as localized and explicitly stored and they may be represented as symbols. They may in turn be accessed by procedural laws.

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1. 'it is a visible consequence of the overall system organisation' - an 'epiphenomenon' (Hofstadter, p.308)

Human beings seems to have a declarative representation of its procedural laws. For example, in most people we find along with a powerful procedural representation of the grammar of their native language, a weaker declarative representation (prototype) of it. It should be noted, however, that procedural knowledge and its prototype need not necessarily be in agreement. Declarative representation of grammar, for example, contradicts in some cases with the intutive sense of the native speaker.

In light of the above discussion on symbols and their multilevels, we wish to make following comments regarding the human mind and its capacity to deal with these multilevels.

Firstly, the capacity of human mind to evolve higher levels of symbols and their inter-relations from their lower level ones gives it the capability to have a world of its own. It helps us to create an intentional description (of things) which can 'float without being anchored down to specific objects -- it gives us the ability to imagine hypothetical world, to amalgamate different discriptions or to chop one description into separate peices and so on' (Hofstadter pp. 335-339).

Zadigs' story (Appendix II) illustrates the difference between the intentional and the extentional world. Zadig

seems to have furnished an intentional description of a Spaniel lame bitch having long ears, which had puppies recently on the basis of the symbols and triggering paths existing in his mind and which could be activated by the signs such as foot impressions on the sand. This intentional representation had no direct reference to Queen's bitch. The Queen's Eunuch, on the other hand, had only an extensional interpretation of what Zadig said.

The human mind seems to have a remarkable capability to deal simultaneoulsy with the large number of levels. These levels may be hierarchically or heterarchically related. i.e., they may form simple or a strange loop. It is interesting to note at this stage what Hofstadter says

> '------ The explanation of "emergent" phenomena in our brains - for instance, ideas, hopes, images, analogies, and finally consciousness and free will - are based on a kind of Strange Loop, an interaction between levels in which the top level reaches back down towards the bottom level and influences it, while at the same time being itself determined by the bottom level --- . The self, comes into being at the moment it has the power to reflect itself'
>
> (Hofstadter ; p. 709)

It seems impossible to deal simultaneously with many levels except in cases when these levels are conceptually distinct and one can maintain the difference between them. A

description of human body at the level of organs, for example, is conceptually distinct from that at the level of cells of genes.

A confusion between these different levels of symbols leads to mixing of levels. A confusion between the notions of intelligence and consciousness for example is a result of the conceptual closeness of these symbols.

It may be suggested that the capability of the human mind to cross the boundary between levels makes analysis of the human mind extremely difficult.

4.3.2 Isomorphism between minds of Human Beings

The above discussion on symbols, their evolutions and their interrelations in human mind is by no means exhaustive. It is more like pointing a finger towards its complexities or suggest a possible method to investigate into human mind. Even though it is a very simplified version of process in human mind it is, nevertheless, able to provide us an idea about the possible complexities of the communication process between minds.

Given this complex, flexible and probabilistic development of symbols and their interrelations (triggering paths)

in a probabilistic environment one wonders as to how it is possible for human beings to communicate at all. We shall briefly discuss this point before developing a tentative model (if possible) for the communication process.

Despite the differences arising from the complex and probabilistic development of symbols and their triggering patterns, there exists some isomorphism (partly global and partly local) between different human minds[1]. We shall call it partial or quasi isomorphism. A complete functional isomorphism would demand a correspondence both at the levels of symbols and their triggering patterns. Such an isomorphism never exists between minds. Even the same mind, at two different instances of time, seems to vary substantially.

It is difficult to give satisfactory account of the notion of partial isomorphism between human minds. It may be due to the fact that there is no adequate way to represent symbols and their triggering patterns in human minds. All that could be talked about is only a part of the whole network and that too with particular perspectives. Fig. 4.2, shows a part of network seen from the perspective of conceptual nearness. Moreover, the development of symbols and interrelations are probabilistic in nature.

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1. 'we have an intutive sense that although other people differ from us in important ways, they are still 'the same' as we are in some deep and important ways'

(Hofstadter ; p. 375)

The notion of partial isomorphism is closely linked to the question 'when two things are similar?' This question has been discussed earlier in some detail. The partial isomorphism notion, like the notion of similarity, can atmost be defined in terms of concepts like 'style', 'form' etc. which themselves are defined in an ambiguous manner. We, however, have an intuitive sense of these terms.

Similarity of 'forms' or 'styles' may have both global and local nature. That is, there may be similarity either at the level of overall behaviour or at the level of behaviour of some parts. The idea of partial isomorphism is best exemplified by Hofstadter in his ASU (Alternative Structure of the Union) example (Hofstadter, pp 373-383). In this example we are asked to convert the given map containing geographical details like rivers, mountains, lakes and so on into a road atlas of USA using our imagination. There will be similarities between this map (ASU) and the USA map both at global and local levels. The global level similarity will be due to the correspondence between big cities and highways, whereas, the local level similarity may be due to the correspondence between familiar places and pathways.

4.3.3 The Concept of Meaning

In section 4.1 and 4.2 we discussed at length the notion of meaning in formal systems and human communication process(es) mainly to highlight the complex nature of 'meaning' as commonly used. Section 4.3 discussed the nature of symbols and their representations in the mind and the capacity of the mind to deal with different levels of symbols. The heterarchical relations between different levels of symbols makes the analysis of human communication process extremely difficult and cannot be subjected to a reductionist approach.

In light of the foregoing, it does not seem possible at this stage to provide a meaningful definition of meaning which may be used for the purpose of analysing human communication process. However, there have been many attempts to capture meaning in terms of other words. For instance, we can find the following definitions of meaning (C.K. Ogden et. al.; pp. 186-187)

1. An intrinsic property
2. A unique unanalysible relation to other things.
3. The other words annexed to a word in the Dictionary.
4. The connotation of a word.
5. An essence

6. An activity projected into an object
7. An event intended
8. A volition
9. The place of anything in a system
10. The practical consequences of a thing in our future experience
11. The theoretical consequences involved in or implied by a statement.
12. Emotion aroused by anything.
13. That which is actually related to a sign by a chosen relation.
14. The Mnemic effects of a stimulus Associations acquired.
15. Some other occurence to which the mnemic effects of any occurence are appropriate.
16. That which a sign is interpreted as being of
17. What anything suggests

In the case of symbols -

1. That to which the uses of a symbol actually refers.
2. That to which the uses of a symbol ought to be refering.

3. That to which the user of a symbol believes himself to be referring.
4. That to which the interpreter of a symbol
   a) Refers
   b) Believes himself to be referring
   c) Believes the user to be referring.

It is interesting to observe that all definitions considered together leave a large number of cases uncovered when it comes to defining meaning. Therefore, all that we may suggest, for limited purposes of this thesis, is that meaning arises when a given set of symbols with their interrelations (say a sentence) corresponds to or is able to activate a portion of our mental world. Mental world in our case is the world of symbols and their interrelations present in our minds.

In light of the above suggestion there may be many meanings of a given set of symbols in direct correspondence with the set of possible triggering paths activated by the symbols. The choice of a particular meaning depends, either, upon the subsequent symbols or the most likely triggering path, when subsequent symbols are absent.

As an illustration consider Zadig's story again. The manner in which Zadig extracted meaning out of signs of

animals' tracks on the sand (environment) may be explained in light of the definition of meaming given above in the following manner. He could make meaningful conclusions from the signs because, he had symbols corresponding to these signs and had triggering paths relating these different symbols in his mental world. On the other hand, queen's eunuch could not draw such conclusions as he had no symbols and triggering paths corresponding to these signs and their relations.

Moreover, it should be noted that the symbol 'dog' activated a large number of triggering paths in Zadig's mental world which in turn got narrowed down by the activation of subsequent symbols. This finally led him to conclude that the dog must be 'a spaniel lame bitch, having long ears, which had puppies recently.

The notion of meaning discussed in this section is by no means exhaustive. However, it provides a framework for understanding certain aspects of human communication process. In the next section, an attempt will be made to explore the possibility of modelling human communication process on the basis of foregoing discussions.

Before concluding this section we like to note that in our concept of meaning, a set of symbols has a meaning in virtue of the triggering paths it activates and is defined with respect to the associated symbols both in the external world and the mental world. We have not considered meaning in terms of use it is put to. This could be achieved by arguing that the triggering paths essentially shows its possible impact on other symbols and on the overall system.

4.4 'Modelling' the Communication Process

Our attempt to explicate the concept of meaning in the foregoing section revealed several complexities involved in the communication process. We recall that providing a satisfactory account of the working of the human mind is rendered difficult on two counts.

Firstly, there seems to be a very large number of symbols which are integrally related to each other. At best, one could endeavour to draw a network of a part of these symbols and their interrelations with respect to a particular perspective. Such a network is shown in Fig. 4.2. This network, though sufficiently complex and intractable, is nevertheless only a 'part' of the 'whole' network and is based on the notion of

'conceptual nearness'. (Clearly there can be manymore perspectives).

Secondly, the problem arising in our effort to provide an account of the human mind, is that both relations and context do not in most situations, admit of specification with any certainty. Moreover, neither all possible relations nor all possible contexts can be enumerated. We can only talk of those which seem to be more or less likely.

Furthermore, the symbols and their relations considered above are not all of the same level and logical typing. Anotherway, to look at these varied levels, would be to consider the context of discourse (for details please refer to Chapter 3). Context of communication specifies from amongst a large number of levels, one or more particular levels, at which communication takes place. For example, when we are involved in scientific activities, our basic symbols are mass, energy, length, time, space etc; and, the interrelations between these symbols are expressed by different laws such as Newton's gravitational law, Einstein's mass energy relations etc. However, when we shift to a 'higher' level, say, the socio-economic reality, these symbols may not be of much help and consequently, both symbols and their relations of discourse would change. We, now, pro-

bably will have symbols like means of production, class, wealth, government etc., and, their interrelations such as relations of production, exchange, equality, freedom, exploitation and so on.

As the human mind has the capability to continuously shift from one level to the other, a system modelling the human mind, therefore, will have to account for both symbols and relations in each of the different levels and the process of shifting as well as the interrelations between these levels.

The situation is further complicated by the fact that the relations[1] between the system and environment or between different levels of system or environment is not hierarchical but heterarchical. As mentioned earlier, the higher level symbols are capable of being fed back as 'inputs' to the lower level symbols.

Human biological systems are best examples of these heterarchical relations. Human psyche seems to have influence on body functions; psychosomatic disease being an expression of it. The body in turn seems to effect the psyche.

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1. It is important to note here that the relation between different levels is not of the same nature as that within the level. The former calls for crossing of boundary between the levels and cannot be accounted for by any system of knowledge based on symmetry of levels.

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Another example of heterarchical nature of system-context relationship can be taken from modern science. One may plaussibly argue that modern science has been, and, is partly, the product of the existing socio-economic reality. This, however, in turn influences and reinforces the nature of socio-economic reality. It, for example, gives rise to an isolated Lockean individual entering into a contract in a free society (or free market).

The symbols and relations at any given level, furthermore, are not static in nature. They continuously keep on getting updated depending upon the environmental and internal conditions. In case of communication, symbols and relations, of both the receivers and the senders, get modified by their relation to each other (communicants).

To sum up, the above considerations suggest that a system in order to 'model' the communication process needs to fulfil the following requirements. It should provide an account of the symbols and their interrelations in the real context in which they are embedded. This in turn would call for the following.

Firstly, our model will have to account for real context. Real context however, as discussed in Chapter 3, is not accessible to analysis. Any analysis presumes a punctuation and puncutation calls for motive. Corresponding to a given motive, we will have different levels and dimensions of both the system and the environment.

Secondly, given a motive, and, therefore, a particular punctuation, it needs to account for different levels arising under this punctuation, symbols and their relations at each level and relations between different levels. Furthermore, it needs to account for the heterarchical relations between different levels.

Thirdly, in case of communication, it needs to account for the relations between different levels at the sender and the receiver /and between their symbols and interrelations. ends

Let us now look into the possibility of developing a model for the communication process.

In Chapter 3, it was suggested that the perceived reality, when punctuated with a motive may have many levels and dimensions. This provides us with a framework on which a model for the communication process can be developed. Given

the motive and the resulting levels and dimensions with their relations both at the receiver and the sender ends, and the relations between different levels and dimensions at the two ends, one can specify and develop a model for the communication process between two or more communicators, and thereby predict the degree of success or failure of communication.

This, however, remains a framework only and does not lend itself to the specification of an operational model for the reason that, firstly, there seems to be no way to elicit motives and conditions under which they arise with any certainty, and secondly, given a motive elaboration of the levels, relations between them and symbols and their relations at each of these levels seems in most real life situations an elusive task. More so, even communicators, not to say of the modeller, in most cases, do not seem to know about these motives and symbols - i.e. he may not have a declarative representation of how he does these things. Furthermore, in case he has a declarative representation, it may not be coherent or even consistent. After all, it is the inseperable difficulties that one encounters and the innumerable errors that one is prone to in understanding the context that makes the process of communicating with the 'other' both enchanting and disastrous.

From the above considerations, it is evident that if only these condition could be specified, it will be possible to spell out a precise model for any specific communicational situation. Indeed, we wish to claim that the different communication models-pragmatic, semantic or syntactic - discussed earlier-on could be subsumed within the framework developed in this thesis, to yield specific models capable of accounting for one or more levels of communication . Consider for example, Yovits' pragmatic model. Here, both the context and the system are completely specified. A punctuation is assumed under which the context acts on the system in a specified manner i.e. through the variable v_{ij}'s (value of a particular course of action). Entities such as courses of action, observable outcomes etc. and their relations such as w_{ij}'s, EV_i's, P(a)'s, C_k's etc. are all specified.

It may be interesting to note here that a different punctuation which leaves the whole model unchanged is the interchange of v_{ij} with w_{ij}, that is the assumption that context acts on system so as to define the relation between the course of actions and outcomes, and that v_{ij}'s for these combinations are given within the system. In fact, many more such punctuations can be suggested in this regard. We, for

example, can take both v_{ij}'s and w_{ij}'s within the system, or both given by the context.

The semantic model of Bar-Hillel is obtained when firstly, system is completely closed to (isolated from) the environment; secondly, many levels of symbols are reduced to one; and finally, symbols and their interrelations (V, ' etc.) are completely specified by logical probabilities. Shannon model is obtained through a similar process of reduction and specification except that in this case relations are determined by statistical probabilities.

CHAPTER 5.

CONCLUSION

The tragic failure of modern man to communicate even within his local habitat, despite the diverse and sophisticated systems of communication, raised certain doubts about the validity of the contemporary, dominant models of communication processes. This led us to analyse these different dominant models in order to understand their basic approach towards the communication process and its relationship to this failure of communication. Our analysis revealed that these models - syntactic, semantic or pragmatic- are by their very nature decontextualizing and reductionist in nature. They tend to replace the world of 'values' by the world of facts and more often they assert 'facts' as 'values'. No wonder, medium becomes message.

An examination into the source of this decontextualization was, therefore, undertaken in Chapter 3. Some of the important conclusions drawn in the light of an alternative epistemology developed in this chapter are :

1. Reality is incomprehensible in terms of a formal system, however complex. The very process of digitalization intro-

duces 'gaps' which are unbridgeable. Every formal knowledge system is a result of a particular punctuation which, in turn, calls for a 'motive'. All knowledge systems in this sense, are instrumental, and contextual. The context, in which knowledge system is used, gives it its semantic-pragmatic values. This relativity of knowledge systems, however, does not mean that they are all equal. Knowledge, though itself a result of a particular punctuation of reality, nevertheless, influences and modifies reality. They, in this sense, are dialectically related to reality which gives rise to them. It is this effect of knowledge systems on reality which provides us with a criterion to judge one knowledge system over the other. Knowledge systems which are conducive to long term survival are preferred over those which contribute to short-term survival. Furthermore, depending upon the context, a punctuation may lead to many levels and at each of the given levels, to many dimensions. A knowledge system needs to take into account these various levels and their inter relations.

2. Punctuation or digitalization seems unavoidable in case of sharable knowledge systems. But, digitalized 'categories' - 'entities' - can be used as symbols related to reality or may be given an independent ontological status. The former

results in a Symbolic system while the latter is an Imaginary one. It is the dominance of the Imaginary over the Symbolic that seems to render any knowledge system oppressive.

Discussion, in Chapter 4, on the concept of meaning in formal and natural systems, in the light of the above epistemology, discloses that meaning involves very large number of levels and their interrelations. Moreover, every level involves, possibly, a large number of symbols and their relations. This situation is further complicated by the human capacity to shift levels, depending upon the context.

An investigation into the possibility of developing a model, in section 4.4, suggests that, though this epistemology provides a frame work to develop a model for communication process, the process of modelling a specific communication situation is rendered difficult and even impossible in many cases, on account of our incapability to describe motives and to specify levels of symbols and their interrelations (even when motive is given) with any certainty. It is further noted that in most of the cases, even the communicators may not be aware of all these motives, levels and their interrelations.

However, given these specifications, it is possible to develop a model. It is also argued that the framework developed provides satisfactory accounts of the different models of communication considered in the earlier sections of the thesis.

Perhaps, it is appropriate to conclude this thesis by observing that the framework provided here in terms of levels and dimensions itself constitutes a particular punctuation. Hopefully, it may have succeeded in locating the causes of our contemporary failure to communicate and to that extent may have contributed to renew our efforts for authentic communication that enables one to share one's perceptions with the other without necessarily conforming to the perceptions of the other. But it is no way implied that performing this particular punctuation is essential to establishing the process of authentic communication.

... If name be needed, wonder names them both:
From wonder into wonder
Existence opens.'

(Lao Tzu, p.25)

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APPENDIX I

ANALOG & DIGITAL SYSTEMS

A Table of Relations

	ANALOG FORM	DIGITAL FORM
	Computation	
1.	Continious scale	Descrete units (on/off)
2.	Positive, actual quantities	Positive and negative representations of quantities
3.	Quantitative plentitude	Logical Complexity
4.	No Zero	Dependent on zero
5.	No absence	Dependent on 'gaps' between the elements
6.	Always something or something else	All, some, nothing or less than nothing
7.	Units of computation may be repeatedly divided	Units of computation can't be divided below the level of the descrete unit.
8.	Computation is imprecise and not related to capacity	Precision is a function of capacity
9.	High signal-to-noise ratio	Low signal to noise ratio
10.	Concrete, necessary	Abstract, Arbitrary
11.	No truth functions	Logical calculas
	ANALOG ASPECT	**DIGITAL ASPECT**
	Interorganismic Communication	
1.	Sequence, rhythm, frequency, spatial patterning	On-off firing of neurons, logical network
2.	Memory trace (pattern)	Decision, Recall

Interorganismic Communication

(Except language)

1. Distinctions establihsed by the receiver	Distinctions established by the sender
2. Context of all communication	Text of particular communication
3. Concerns relations, connections, wholes, systems	Represents limits
4. Sequence and simultaneity	Combination
5. Contiguity	Combination
6. Similarity	Substitution

Logical Distinctions

1. Concrete	Abstract
2. Territory	Map
3. Refusal	Absence, Zero
4. 'More or less'	'Either/or'
5. Difference & Similarity	Opposition and identity
6. No logical typing	Logical typing
7. Can't communicate about itself	Communication about communication
8. Semantic Pragmatic	Syntactic
9. Meaning	Signification
10. Sequence and simultaneity	Space and time coordinates
11. Continious	discontinious

12. Full	Full of holes
13. Whole, Relations	Elements, entities
14. Maps continuum precisely	can only map boundaries precisely
15. Presence and absence (Paradoxical logic)	Presence or absence
16. Similarity and conguity	Code and message, substitution and combination
17. 'Pre-categorical'	'Categorical'
18. Can represent successions simultaneously	Indicates simultaneities succesively
19. Observer <u>in</u> the system	Observer assumed to be <u>outside</u> the system
20. 'Subjective' (contexual)	'Objective'
21. Knowledge of 'relations'	Knowledge of 'facts'
22. Relativistic	Absolutist
23. Ecosystems	Entities
24. Open systems	Closure
25. Free flow of <u>meaning</u>	Binding of signification
26. 'untamed thought' (la pensee saiuage)	'Scientific thought'; rationalism, Empiricism
27. Connaitre	Savoir

Human Communication

1. Senses	Denotive languages
2. 'Emotion'	'Reason'
3. Evocation of relation	Transmission of Abstraction

4. Presenting	Naming
5. Rich relational Semantics (ambigious)	Powerful syntactics (unambigious); weak Semantic
6. Position, Context, Situation	Text, message
7. Memory	Rememoration
8. Understandings	Arguments, Codicils
9. Pain is pain, paim is a sign.	'Pain' is a signifier
10. 'Natural body movements	Conventionalised body movements.
11. Thing-presentation (Sochvorstellung)	Word-presentation (Wortvorstellung).
12. Images, icons	Signifiers
13. 'Natural' symbols	Artificial or conventional symbols
14. Similarity and contiguity	Metaphor and metonymy
15. Difference and similarity	opposition & identity
16. Interactive	Individual

Language

1. Refusal, repudiation, rejection, disavowal	Negation
2. Refrent, goal.	Words, means
3. Relationship	concepts
4. Evocation	Information
5. Connotation (meaning)	Denotation (Signification)
6. Command or Request	Report

7.	Semantic-Pragmatic	Syntactic
8.	Present	Past, present and future
9.	Shifters	Nouns
10.	Typography, intonation, cadence loudness, frequency	Alphabets, phonemes
11.	Poetry	Prose
12.	Evocation of Images	Information about concepts

Systems

1.	Relationships	Entities
2.	Use value (Real)	Exchange value (symbolic or Imaginery)
3.	More-or-Less	Either/or
4.	Symbolic	Symbolic & Imaginery
5.	Aufhebung	Verneinung
6.	Process	Events
7.	Quality	Quantity

(Wilden pp. 192-195)

APPENDIX II

INTENSIONAL vs. EXTENSIONAL MAN

Following is an excerpt from Voltaire's 'Zadig and Other Romances'. It serves to illustrate the communicational mish-mash we may get involved in and the semiotic agony we may suffer.

VOLTAIRE's TEXT

Zading found that the first moon of marriage, even as it is written in the book of Zend, is of honey, and the second of wormwood. After a time he had to get rid of Azora, who had become too difficult to live with, and he tried to find his happiness in the study of nature. 'No one is happier', said he, 'than a philosopher who reads in this great book that God has placed before our eyes. The truths he discovers belong to him. He nourishes and ennobles his soul. He lives in peace, fearing nothing from men, and his dear wife does not come to cut off his nose'.

Filled with these ideas, he retired to a house in the country on the banks of Euphrates. There he did not pass his time calculating how many inches of water flow in one second under the arches of a bridge, or if a cubic line more rain fell in the month of the mouse than in the month of the sheep. He did not contrive to make silk from spiders' webs, or porcelain from broken bottles; but he studied above all the characteristics of animals and plants, and soon acquired a perspicacity which showed him a thousand differences where other men see only uniformity.

While walking one day near a little wood he saw one of queen's eunuchs hastening towards him, followed by several officers, who seemed to be greatly troubled, and ran hither and thither like distracted men seeking something very precious they have lost.

'Young men', cried the Chief Eunuch, 'you haven't seen the queen's dog, have you?'

'It's not a dog,' answered Zading modestly, 'It's a bitch.'

'That's so,' said the Chief Eunuch.

'It's a very small spaniel,' added Zadig, 'which has had puppies recently; her left forefoot is lame, and she has very long ears'.

'You have seen her then?' said the Eunuch, quite out of breath.

'Oh, no!' answered Zadig. 'I have not seen the animal, and I never knew the queen had a bitch'.

Just at this moment, by one of the usual freaks of fortune, the finest horse in the king's stables escaped from a groom's hands and fled into the plains of Babylon. The Master of the King's Hounds any all the other officials rushed after it with as much axniety as the Chief Eunuch after the bitch. The Master of the King's Hounds came up to Zadig and asked if he had not seen the king's horse horse pass by.

'The horse you are looking for is the best galloper in the stable,' answered Zadig. 'It is fifteen hands high, and has a very small hoof. Its tail is three and a half feet long. The studs on its bit are of twenty-three carat gold, and its shoes of eleven scruple silver.'

'Which road did it take?' asked the Master of the King's Hounds.

'Where is it?'

'I have not seen the horse,' answered Zading, 'and I have never heard speak of it'.

The Master of the King's Hounds and the Chief Eunuch had no doubt but that Zadig had stolen the king's horse and the queen's bitch, and they had him taken before the Grand Destur, who condemned him to the knout and afterwards to spend the rest of his days in Siberia. Hardly had judgement been pronounced than the horse and the bitch were found. The judges were in the sad necessity of having to rescind their judgement, but they condemned Zadig to pay four hundred ounces of gold for having denied seeing what he had seen. Only after the fine had been paid was Zadig allowed to plead his cause, which he did in the following terms.

'Stars of Justice,' he said, 'Unfathomable Wells of knowledge, Mirrors of Truth, that have the solidity of lead, the hardness of iron, the radiance of the diamond, and much affinity with gold, since I am permitted to speak before this august assembly, I swear to you by Ormuzd that I have never seen the queen's honourable bitch or the king of kings' sacred horse. Let me tell you what happened.

'I was walking toward the little wood where I met later the venerable Chief Eunuch and the very illustrious Master of the King's Hounds. I saw an animal's tracks on the sand and I judged without difficulty they were the tracks of a small dog. The long, shallow furrows printed on the little ridges of sand between the tracks of the paws informed me that the animal was a bitch with pendent dugs, who hence had had puppies recently. Other tracks in a different direction, which seemed all the time to have scraped the surface of the sand beside the fore-paws, gave me the idea that the bitch had very long ears; and as I remarked that the sand was always less hollowed by one paw than by the three others, I concluded that our august queen's bitch was somewhat lame, if I dare say so.

'As regards the king of Kings' you may know that as I walked along the road in this wood I saw the marks of horse-shoes, all equal distances apart. That horse, said I, gallops perfectly. The dust on the trees in this narrow road only seven feet wide was raised a little right and left three and a half feet from the middle of the road. This horse, said I, has a tail three and a half feet long, and its movement right and left has swept up this dust. I saw beneath the trees, which made a cradle five feet high, some leaves newly fallen from the branches, and I recognised that this horse had touched there and was hence fifteen hands high. As regards his bit, it must be of twenty-three carat gold, for he rubbed the studs against a stone which I knew to be a touchstone and tested. From the marks his hoofs made on certain pebbles I knew the horse was shod with eleven scruple silver'.

All the judges admired Zadig's profound and subtle perspicacity, news of which came to the ears of the king and queen. In the anterooms, the throne-room, and the closet Zadig was the sole topic of conversation, and although several of the Magi thought he should be burned as a sorcerer, the king ordered the fine of four hundred ounces of gold to which he had been condemned to be returned to him. The clerk of the court, the ushers, the attorneys called on him with great pomp to bring him these four hundred ounces. They retained only three hundred and ninety-eight for judicial costs, and their lackeys demanded largess.

Zadig saw how dangerous it was sometimes to be too knowing, and promised himself, on the first occasion that offered, not to say what he had seen.

The occasion soon presented itself. A stage prisoner escaped, and passed beneath the window of Zadig's house. Zadig was questioned,

and made no reply. But it was proved he had looked out of the window. For this crime he was condemned to five hundred ounces of gold, and, as is the custom in Babylon, he thanked his judges for their indulgence.

'Good God!' He said to himself. 'A man who walks in a wood where the queen's bitch or the king's horse has passed is to be pitied! How dangerous it is to look out of the window! How difficult it is to be happy in this life!'

(Vaina L & Hintikka 1984)

APPENDIX III

CONTRACROSTIPUNCTUS

Achilles has come to visit his friend and jogging companion, the Tortoise, at his home.

Achilles : Heavens, you certainly have an admirable boomerang collection!

Tortoise : Oh, pshaw. No better than that of any other Tortoise. And now, would you like to step into the parlor?

Achilles : Fine. (Walks to the corner of the room.) I see you also have a large collection of records. What sort of music do you enjoy?

Tortoise : Sebastian Bach isn't so bad, in my opinion. But these days, I must say, I am developing more and more of an interest in a rather specialized sort of music.

Achilles : Tell me, what kind of music is that?

Tortoise : A type of music which you are most unlikely to have heard of. I call it 'music to break phonographs by'.

Achilles : Did you say 'to break phonographs by'? That is a curious concept. I can just see you, sledgehammer in hand, whacking one phonograph after another to pieces, to the strains of Beethoven's heroic masterpiece Wellington's Victory.

Tortoise : That's not quite what this music is about. However, you might find its true nature just as intriguing. Perhaps I should give you a brief description of it?

Achilles : Exactly what I was thinking.

Tortoise : Relatively few people are acquainted with it. It all began when my friend the Crab-have you met him, by the way? - paid me a visit.

Achilles : 'twould be a pleasure to make his acquaintance, I'm sure. Though I've heard so much about him, I've never met him.

Tortoise : Sooner or later I'll get the two of you together. You'd hit it off splendidly. Perhaps we could meet at random in the park one day...

Achilles : Capital suggestion! I'll be looking forward to it. But you were going to tell me about your weird 'music to smash phonographs by', weren't you?

Tortoise : Oh, yes. Well, you see, the Crab came over to visit one day. You must understand that he's always had a weakness for fancy gadgets, and at that time he was quite an aficionado for, of all things, record players. He had just bought his first record player, and being somewhat gullible, believed every word the salesman had told him about it--in particular, that it was capable of reproducing any and all sounds. In short, he was convinced that it was a Perfect phonograph.

Achilles : Naturally, I suppose you disagreed.

Tortoise : True, but he would hear nothing of my arguments. He staunchly maintained that any sound whatever was reproducible on his machine. Since I couldn't convince him of the contrary, I left it at that. But not long after that, I returned the visit, taking with me a record of a song which I had myself composed. The song was called 'I Cannot Be Played on Record Player 1'.

Achilles : Rather unusual. Was it a present for the Crab?

Tortoise : Absolutely. I suggested that we listen to it on his new phonograph, and he was very glad to oblige me. So he put it on. But unfortunately, after only a few notes, the record player begain vibrating rather severely, and then with a loud 'pop', broke into a large number of fairly small pieces, scattered all about the room. The record was utterly destroyed also, needless to say.

Achilles : Calamitous blow for the poor fellow, I'd say. What was the matter with his record player?

Tortoise : Really, there was nothing the matter, nothing at all. It simply couldn't reproduce the sounds on the record which I had brought him, because they were sounds that would make it vibrate and break.

Achilles : Odd, isn't it? I mean, I thought it was a Perfect phonograph. That's what the salesman had told him, after all.

Tortoise : Surely, Achilles, you don't believe everything that salesmen tell you! Are you as naive as the Crab was?

Achilles : The Crab was naiver by far! I know that salesmen are notorious prevaricators. I wasn't born yesterday!

Tortoise : In that case, maybe you can imagine that this particular salesman had somewhat exaggerated the quality of the Crab's piece of equipment ... perhaps it was indeed less than Perfect, and could not reproduce every possible sound.

Achilles : Perhaps that is an explanation. But there's no explanation for the amazing coincidence that your record had those very sounds on it ...

Tortoise : Unless they got put there deliberately. You see, before returning the Crab's visit, I went to the store where the Crab had bought his machine, and inquired as to the make. Having ascertained that, I sent off to the manufacturers for a description of its design. After receiving that by return mail, I analyzed the entire construction of the phonograph and discovered a certain set of sounds which, if they were produced anywhere in the vicinity, would set the device to shaking and eventually to falling apart.

Achilles : Nasty fellow! You needn't spell out for me the last details: that you recorded those sounds yourself, and offered the dastardly item as a gift ...

Tortoise : Clever devil! you jumped ahead of the story! But that wasn't the end of the adventure, by any means, for the Crab did not believe that his record player was at fault. He was quite stubborn. So he went out and bought a new record player, this one even more expensive, and this time the salesman promised to give him double his money back in case the Crab found a sound which it could not reproduce exactly. So the Crab told me excitedly about his new model, and I promised to come over and see it.

Achilles : Tell me if I'm wrong-I bet that before you did so, you once again wrote the manufacturer, and composed and recorded a new song called 'I Cannot Be Played on Record Player 2', based on the construction of the new model.

Tortoise : Utterly brilliant deduction, Achilles. You've quite got the spirit.

Achilles : So what happened this time?

Tortoise : As you might expect, precisely the same thing. The phonograph fell into innumerable pieces, and the record was shattered.

Achilles : Consequently, the Crab finally became convinced that there can be no such thing as a Perfect record player.

Tortoise : Rather surprisingly, that's not quite what happened. He was sure that the next model up would fill the bill, and having twice the money, he-

Achilles : Oho-I have an idea! He could have easily outwitted you, by obtaining a LOW-fidelity phonograph-one that was not capable of reproducing the sounds which would destroy it. In that way, he would avoid your trick.

Tortoise : Surely, but that would defeat the original purpose-namely, to have a phonograph which could reproduce any sound whatsoever, even its own self-breaking sound, which is of course impossible.

Achilles : That's true. I see the dilemma now. If any record player-say Record Player X-is sufficiently high-fidelity, then when it attempts to play the song 'I Cannot Be Played on Record Player X', it will create just those vibrations which will cause it to break ... So it fails to be Perfect. And yet, the only way to get around that trickery, namely for Record Player X to be of lower fidelity, even more directly ensures that it is not Perfect. It seems that every record player is vulnerable to one or the other of these frailties, and hence all record players are defective.

Tortoise : I don't see why you call them 'defective'. It is simply an inherent fact about record players that they can't do all that you might wish them to be able to do. But if there is a defect anywhere, it is not in THEM, but in your expectations of what they should be able to do! And the Crab was just full of such unrealistic expectations.

Achilles : Compassion for the Crab overwhelms me. High fidelity or low fidelity, he loses either way.

Tortoise : And so, our little game went on like this for a few more rounds, and eventually our friend tried to become very smart. He got wind of the principle upon which I was basing my own records, and decided to try to outfox me. He wrote to the phonograph makers, and described a device of his own invetion, which they built to specification. He called it 'Record Player Omega'. It was considerably more sophisticated than an ordinary record player.

Achilles : Let me guess how: Did it have no moving parts? Or was it made of cotton? Or-

Tortoise : Let me tell you, instead. That will save some time. In the first place, Record Player Omega incorporated a television camera whose purpose it was to scan any record before playing it. This camera was hooked up to a small built-in computer, which would determine exactly the nature of the sounds, by looking at the groove-patterns.

Achilles : Yes, so far so good. But what could Record Player Omega do with this information?

Tortoise : By elaborate calculations, its little computer figured out what effects the sounds would have upon its phonograph. If it deduced that the sounds were such that they would cause the machine in its present configuration to break, then it did something very clever. Old Omega contained a device which could disassemble large parts of its phonograph subunit, and rebuild them in new ways, so that it could, in effect, change its own structure. If the sounds were 'dangerous', a new configuration was chosen, one to which the sounds would pose no threat, and this new configuration would then be built by the rebuilding subunit, under direction of the little computer. Only after this rebuilding operation would Record Player Omega attempt to play the record.

Achilles : Aha! That must have spelled the end of your tricks. I bet you were a little disappointed.

Tortoise : Curious that you should think so ... I don't suppose that you know Godel's Incompleteness Theorem backwards and forwards, do you?

Achilles : Know Whose Theorem backwards and forwards? I've never heard of anything that sounds like that. I'm sure it's fascinating, but I'd rather hear more about 'music to break records by'. It's an amusing little story. Actually, I guess I can fill in the end. Obviously, there was no point in going on, and so you sheepishly admitted defeat, and that was that. Isn't that exactly it?

Tortoise : What! It's almost midnight! I'm afrait it's my bedtime. I'd love to talk more, but really I am growing quite sleepy.

Achilles : As am I. Well, I'll be on my way. (As he reaches the door, he suddenly stops, and turns around.) Oh, how silly of me! I almost forgot, I brought you a little present. Here. (Hands the Tortoise a small, neatly wrapped package.)

Tortoise : Really, you shouldn't have! Why, thank you very much indeed. I think I'll open it now. (Eagerly tears open the package, and inside discovers a glass goblet.) Oh, what an exquisite goblet! Did you know that I am quite an aficionado for, of all things, glass goblets?

Achilles : Didn't have the foggiest. What an agreeable coincidence!

Tortoise : Say, if you can keep a secret, I'll let you in on something: I'm trying to find a Perfect goblet: one having no defects of any sort in its shape. Wouldn't it be something if this goblet-let's call it 'G' -were the one? Tell me, where did you come across Goblet G?

Achilles : Sorry, but that's MY little secret. But you might like to know who its maker is.

Tortoise : Pray tell, who is it?

Achilles : Ever hear of the famous glassblower Johann Sebastian Bach? Well, he wasn't exactly famours for glassblowing-but he dabbled at the art as a hobby, though hardly a soul knows it-and this goblet is the last piece he blew.

Tortoise : Literally his last one? My gracious. If it truly was made by Bach, its value is inestimable. But how are you sure of its maker?

Achilles : Look at the inscription on the inside-do you see where the letters 'B', 'A', 'C', 'H' have been etched?

Tortoise : Sure enough! What an extraordinary thing. (Gently sets Goblet G down on a shelf.) By the way, did you know that each of the four letters in Bach's name is the name of a musical note?

Achilles : 'tisn't possible, is it? After all, musical notes only go from 'A' through 'G'.

Tortoise : Just so; in most countries, that's the case. But in Germany, Bach's own homeland, the convention has always been similar, except that what we call 'B', they call 'H', and what we call 'B-flat', they call 'B'. For instance, we talk about Bach's 'Mass in B Minor', whereas they talk about his 'H-moll Messe'. Is that clear?

Achilles : ... hmm ... I guess so. It's a little confusing: H is B, and B is B-flat. I suppose his name actually constitutes a melody, then.

Tortoise : Strange but true. In fact, he worked that melody subtly into one of his most elaborate musical pieces-namely, the final Contrapunctus in his Art of the Fugue. It was the last fugue Bach ever wrote. When I heard it for the first time, I had no idea how it would end. Suddenly, without warning, it broke off. And then ... dead silence. I realized immediately that was where Bach died. It is an indescribably sad moment, and the effect it had on me was-shattering. In any case, B-A-C-H is the last theme of that fugue. It is hidden inside the piece. Bach didn't point it out explicitly, but if you know about it, you can find it without much trouble. Ah, me-there are so many clever ways of hiding things in music ...

Achilles : ... or in poems, Poets used to do very similar things, you know (though it's rather out of style these days). For instance, Lewis Carroll often hid words and names in the first letters (or characters) of the successive line in poems he wrote. Poems which conceal messages that way are called 'acrostics'.

Tortoise : Bach, too, occasionally wrote acrostics, which isn't surprising. After all, counterpoint and acrostics, with their levels of hidden meaning, have quite a bit in common. Most acrostics, however, have only one hidden

level-but there is no reason that one couldn't make a double-decker-anacrostic on top of an acrostic. Or one could make a 'contracrostic' - where the initial letters, taken in reverse order, form a message. Heavens! There's no end to the possibilities inherent in the form. Moreover, it's not limited to poets; anyone could write acrostics-even a dialogician.

Achilles : A dial-a-logician? That's a new one on me.

Tortoise : Correction: I said 'dialogician', by which I meant a writer of dialogues. Hmm ... something just occurred to me. In the unlikely event that a dialogician should write a contrapuntal acrostic in homage to J.S. Bach, do you suppose it would be more proper for him to acrostically embed his OWN name-or that of Bach? Oh well why worry about such frivolous matters? Anybody who wanted to write such a piece could make up his own mind. Now getting back to Bach's melodic name, did you know that the melody B-A-C-H, if played upside down and backwards, is exactly the same as the original?

Achilles : How can anything be played upside down? Backwards, I can see-you get H-C-A-B-but upside down? You must be pulling my leg.

Tortoise : 'pon my word, you're quite a skeptic, aren't you? Well, I guess I'll have to give you a demonstration. Let me just go and fetch my fiddle - (Walks into the next room, and returns in a jiffy with an ancient-looking violin.) - and play it for you forwards and backwards and every which way. Let's see, now ... (Places his copy of the Art of the Fugue on his music stand and opens it to the last page.) ... here's the last Contrapunctus, and here's the last theme ...

The Tortoise begins to play: B-A-C- -but as he bows the final H, suddenly, without warning, a shattering sound rudely interrupts his performance. Both he and Achilles spin around, just in time to catch a glimpse of myriad fragments of glass tinkling to the floor from the shelf where Goblet G had stood, only moments before. And then ... dead silence.

(Hofstadadter pp.75-84)

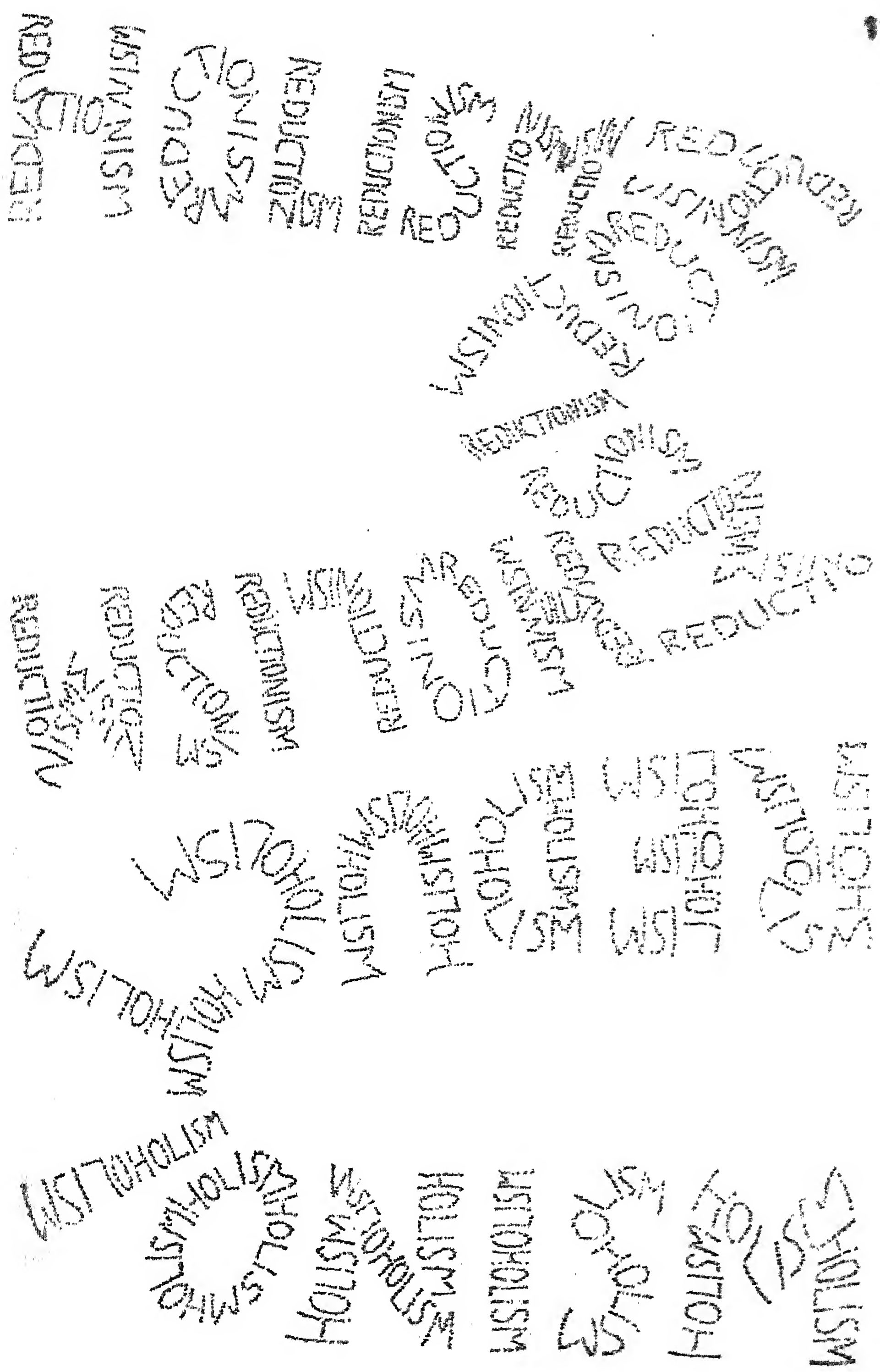

Fig. 5.1 ([illegible])

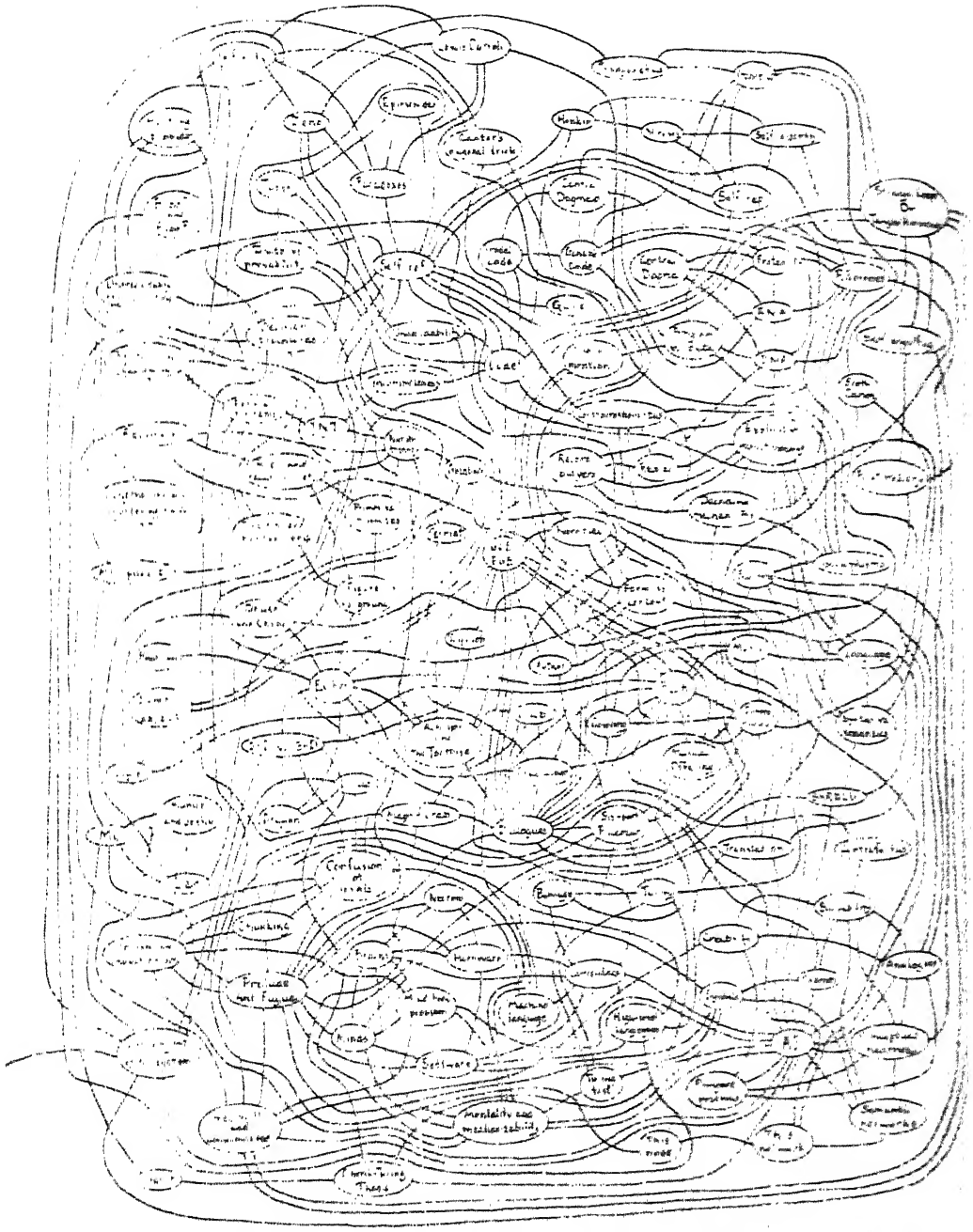

Fig 4-2 A tiny portion of the 'semantic network'

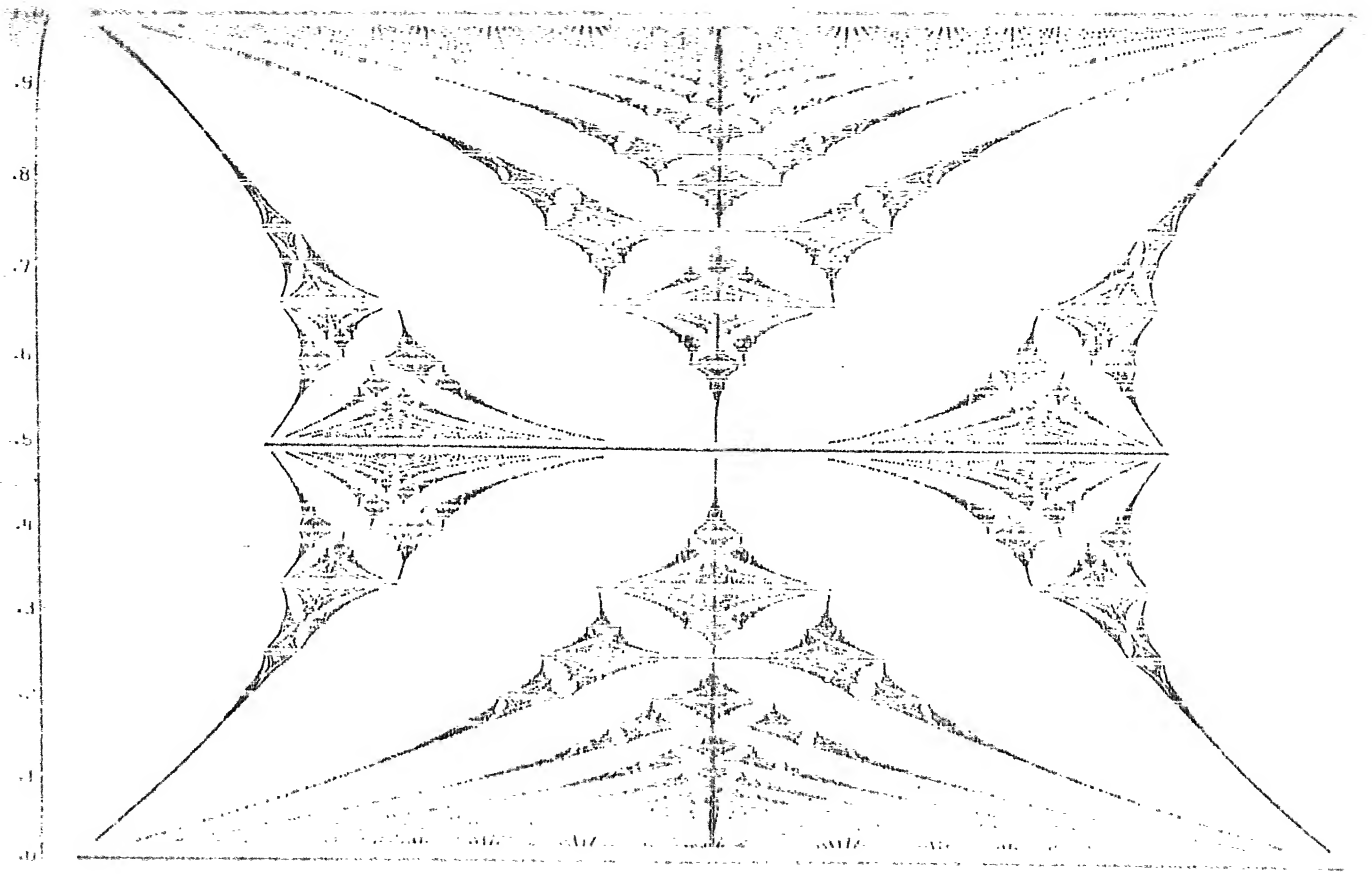

FIGURE 54 Gplot: a recursive graph showing energy bands for electrons in an idealized crystal in a magnetic field vs. reciprocal magnetic pole strength (runs vertically from 0 to 1. Energy runs horizontally. The horizontal line segments are bands of allowed electron energies.

Fig. 4.1.2 Gplot

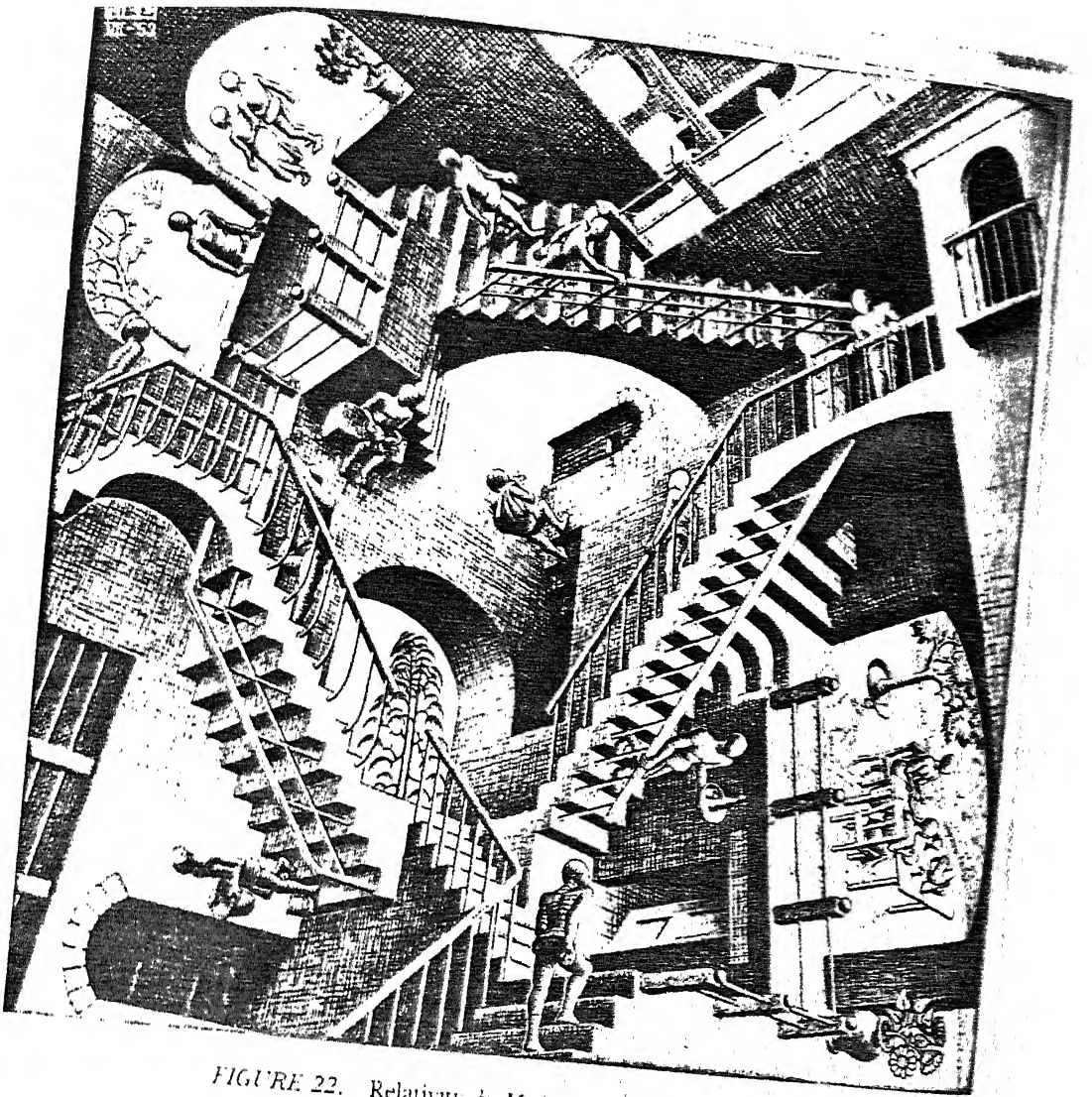

FIGURE 22. Relativity, *by M. C. Escher (lithograph, 1953).*

Fig. 4.1.3 Relativity

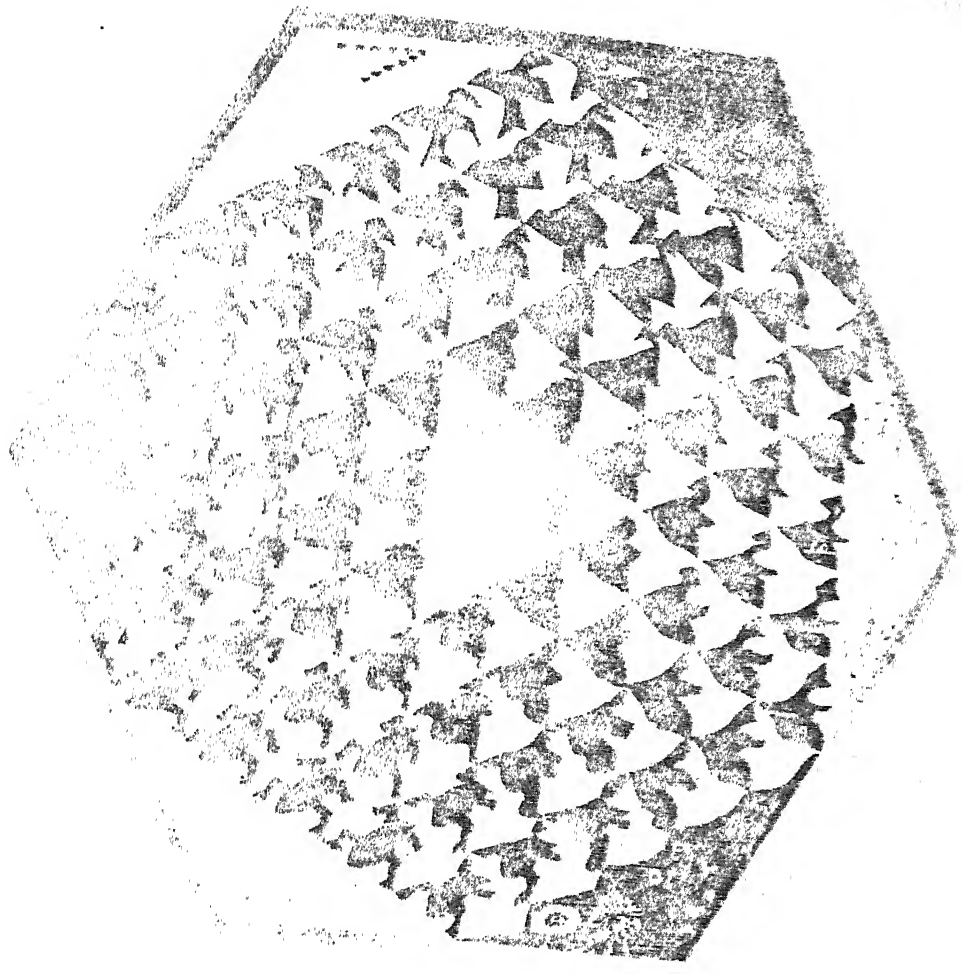

FIGURE 149. Verbum, by M. C. Escher (lithograph, 1942).

Verbum